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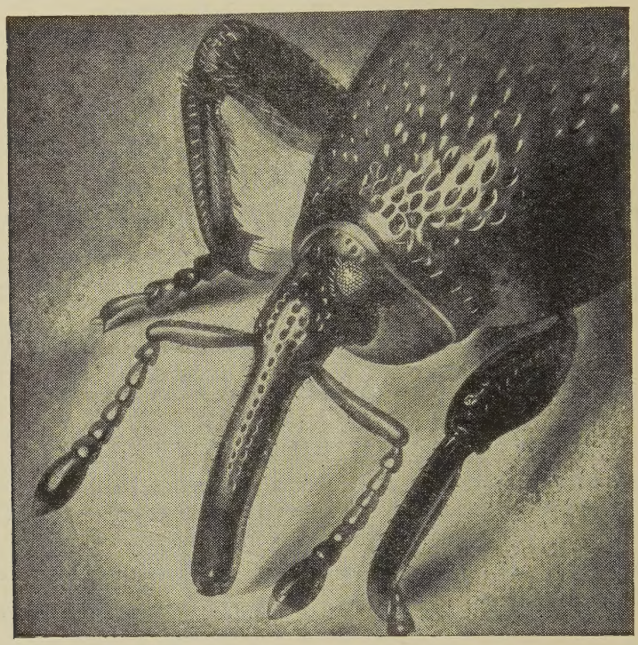

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NIXON (G. E. J.). **The Association of Ants with Aphids and Coccids.**—36 pp., 3½ pp. refs. London, Commonw. Inst. Ent., 1951. Price 5*s*.

The literature relating to the association of ants with Aphids and Coccids is reviewed with reference to the nature of the association, the ants involved, the advantages of the relationship to the Aphids and Coccids (considered from the points of view of the effect on their natural enemies, well-being and dissemination and of the degree of interdependence involved), the effect of the association on the plants, and its economic significance with reference to the use of ants as agents of biological control and to their effect on introduced parasites and predators. In discussing the effect of the association on the plant, it is pointed out that ants may indirectly assist in the spread of virus diseases by fostering the Aphid or Coccid vectors.

The author concludes that the theories advanced from time to time to explain the behaviour both of the ants and of the Aphids and Coccids need drastic modification. It has generally been accepted that the relations between them illustrate a complex and unusually intimate form of symbiosis or mutualism. While this may be true for certain combinations of species of ants and Aphids or Coccids, it is doubtful if the term symbiosis could be used to describe the casual association of some species of ants with their Homopterous food-sources. In removing a waste product, honeydew, such ants may play simply a scavenging rôle, and, except that it is more complicated, their attitude towards the insects excreting the honeydew may not be very different from the kind of response that the nectar of a flower would evoke in them. Herzig [*R.A.E.*, A **26** 195] has suggested that the behaviour of ants towards Aphids is determined by two factors : first, the unpalatability of the Aphids, and second, that the Aphids are stimulated to produce the coveted honeydew by the movements of the ants. The ant is thus both repelled and attracted at the same time, and its attitude may be said to represent a synthesis of two opposing forces. If Herzig's suggestion can be confirmed, it disposes of the common view that there must always exist between the ant and the Aphid or Coccid it attends a special bond uniting their lives to their mutual advantage.

The extent of the mutual benefit gained by the Homoptera and the ants from their association is obviously difficult to estimate but many of the opinions concerning it are based on circumstantial evidence or mere assumption. For instance, there seems to be little proof, except in a few noteworthy cases, that ants play a very active part in the transport and dissemination of Aphids and Coccids, though this is generally taken for granted. It also seems certain that the amount of protection afforded by ants through driving away parasites and predators has been much exaggerated. Even where the association appears to have a fixed and stable quality, its strength may be subject to fluctuations dependent upon various factors. A given association may be close and highly successful in some areas and have no effect on the size and vigour of the Coccid or Aphid populations in others. Whatever may be the true nature of the diverse relations between ants and Homoptera, it is certain that to understand them, the old subjective and picturesque interpretation that ants behave towards Aphids and Coccids as though they are "cattle" requiring to be "milked" and otherwise suitably tended must be abandoned.

ELLIS (P. E.). **The Marching Behaviour of Hoppers of the African Migratory Locust** (*Locusta migratoria migratorioides* **R. & F.**) **in the Laboratory.**—*Anti-Locust Bull.* no. 7 [4+]46 pp., 32 figs., 21 refs. London, 1951.

The following is substantially the author's summary. When well-fed fourth-instar hoppers of *Locusta migratoria migratorioides* (R. & F.) that had been reared at about 31°C. [87·8°F.] and had moulted 2–3 days previously were

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kept at the same temperature without food in batches of 30 in cages 1 ft. square illuminated by a 40-watt water-screened lamp placed centrally overhead, they spent most of their time marching round the cage. They still marched in the presence of suitable food, though to only about half the extent. Marching cannot therefore be regarded as essentially a search for food. From the moment of deprivation of food, the increase in amount of marching corresponded with the decline of alimentary activity, as indicated by the amount of material in the gut ; there was no reduction in the percentage water content of the locusts. In the absence of an overhead lamp, the hoppers did not march but moved about at random. It therefore appears that the hoppers were active except when feeding or resting after a meal, and that random activity developed to gregarious marching with a suitable source of light.

Marching occurred over a considerable range of air temperatures, and persisted longer at 30–35°C. [86–95°F.] than at 37°C. [98·6°F.]. It cannot therefore be regarded as essentially a response to unfavourable temperature conditions, but appears to be a normal activity of gregarious hoppers. Further field observations are required, for up to the present they have often suggested that marching is characteristic of unfavourably high temperatures.

Marching in the field is considered to be a gregarious activity and an activity of phase *gregaria* because it is seen when large numbers of hoppers do it together and *solitaria* hoppers seldom occur in crowds. In a foot-square cage, however, it occurs when only five hoppers are present, though the amount is reduced with fewer than 20, and also occurs in groups of *solitaria* and *gregaria* hoppers or of *solitaria* hoppers alone. In experiments on its relation to phase characters, the ratio of the length of the hind femur (F) to the maximum width of the head (C) was found to be a useful indicator of phase status. Hoppers reared in crowds had the same F/C ratio irrespective of whether their parents were *solitaria* or *gregaria*, though the colour pattern of the progeny of *solitaria* was not fully of the *gregaria* type. On the other hand, progeny of *gregaria* reared in isolation were solitary in colour pattern but were nearly intermediate between *solitaria* and *gregaria* in F/C ratio. *Solitaria* hoppers marched much less and also more slowly than *gregaria* ; *transiens* behaved intermediately, but more like *solitaria* than *gregaria*. That is to say, the *gregaria* F/C ratio was produced immediately by rearing conditions, but the *gregaria* behaviour was not ; in the other direction, *solitaria* behaviour was obtained before the *solitaria* F/C ratio.

The amount of marching in standard conditions did not change much between the second and fifth instars, but it changed very greatly during an instar ; from about the middle of the instar to the end, it fell from a high level to zero, and the hoppers neither fed nor marched on the day before moulting. The two sexes behaved similarly. In otherwise standard conditions, marching was unaffected by an air current of about 50 cm. per second, by radiation from an unscreened 40-watt lamp, and by air humidity. In the presence of food, however, the low level of marching was substantially increased by either the unscreened lamp or the ventilation, and it was increased twice as much when both of these factors acted together. The effects cannot be due purely to a rise of temperature and are attributed to specific activating stimulation.

MONCRIEFF (R. W.). **Mothproofing.**—$8\frac{3}{4} \times 5\frac{1}{2}$ ins., pp. i–xiii, 15–200, 10 pls., 5 figs., 95 refs. London, L. Hill, Ltd., 1950. Price 17*s*.

The opening chapters of this book contain accounts of the appearance and habits of clothes moths, house moths and carpet beetles (*Anthrenus* and *Attagenus*) and the damage that they may cause to wool, fur and feathers. These are followed by information on the numerous chemical processes that have been developed for mothproofing purposes, chiefly for the treatment of

wool during the processes of manufacture. The compounds used are classified as dyestuffs, fluorides, colourless dyestuffs of the triphenylmethane series, Mitin FF, pentachlorophenol, DDT, phosphonium compounds and formaldehyde, and their discovery, chemical constitution, properties and effectiveness are reviewed, largely from the literature. Similar information is given in a later chapter on materials applied for mothproofing during dry-cleaning. Two further chapters deal with the nutritional requirements of the larvae of *Tineola bisselliella* (Humm.) and mothproofing by modification of the molecular structure of wool [*cf. R.A.E.*, A **39** 5, 42]. The last chapters comprise reviews of other ways of preventing infestation, some domestic in character, and of controlling it, methods of rearing clothes moths and carpet beetles for experimental purposes and techniques that have been adopted for assessing the degree of resistance conferred by mothproofing processes.

SCHNEIDER-ORELLI (O.) & KUHN (W.). **Weitere Untersuchungen in schweizerischen Borkenkäferherden.** [Further Investigations in Bark-beetle Foci in Switzerland.]—*Schweiz. Z. Forstw.* 1948 no. 9–10 repr. 32 pp., 12 figs., 5 refs. Berne, 1948. (With a Summary in French.)

Observations on *Ips typographus* (L.) on spruce in Switzerland were continued in 1947 and 1948 [*cf. R.A.E.*, A **36** 407] and are described in the first part of this paper. Examination of soil samples from numerous centres of infestation confirmed the finding that great numbers of the adult beetles hibernate in the soil, so that trap-logs may still be required in spring in sites that have apparently been well cleared in winter. Mortality in the soil was very low [*cf.* **38** 467]. Hibernation in the bark of the trees was also of frequent occurrence in the winter of 1947–48, because the hot weather in 1947 induced the adults of the autumn generation to oviposit over a longer period than in 1946, so that larvae, pupae and young adults were still present under the bark in late autumn and remained there for hibernation. Hibernation and feeding in stumps in felled areas was found to be of much less importance than appears to be the case in Germany [*cf.* **38** 164, 467 ; **39** 32], probably because trees in Switzerland are felled much closer to the ground. There is no need, therefore, for special treatment of the stumps. Maturation feeding of the overwintered beetles in spring, as recorded in southern Germany, occurred only in localities bordering on that country, and not in central or southern Switzerland, when the beetles began to form brood galleries in trap-logs soon after they emerged. They emerged from the soil between 14th and 21st April in both 1947 and 1948. Owing to unfavourable weather that began at the end of June in 1948, emergence of young adults of the first generation was delayed till the end of July, but many of the overwintered adults had abandoned their breeding galleries at the end of May and flown to other trees, in which they gave rise to a second brood that developed contemporaneously with the first. The secondary brood galleries were shorter than normal and frequently crooked, and the numbers of larval galleries were much smaller. This occurrence indicated that if a secondary flight of overwintered beetles takes place, fresh trap-logs should be laid out to receive them, even though young adults of the normal spring generation have not yet appeared.

Chemical control of *I. typographus* is seldom necessary in Switzerland. Water for sprays could not be obtained in the mountains, but dusts might serve as a supplement to the main measures of felling and barking infested trees and laying out trap-logs. Dusts of DDT or benzene hexachloride applied to the surface of the soil gave no control of the adults hibernating in it. Scorching the soil to destroy the beetles has been recommended, but involves too great a risk of forest fires, especially in dry areas. A survey in July 1948 showed that the intensive campaign carried out against *I. typographus* since 1946 had

reduced its numbers to their original level without recourse to insecticides or to scorching of the soil. The results achieved in three different localities are cited as examples and illustrated on a graph, which also shows for comparison the remarkable increase in infestation in 1947 in the Black Forest region of Germany, when control had been less thoroughly carried out.

The second part deals with an injurious outbreak of *I. curvidens* (Germ.), sometimes accompanied by *I. spinidens* Rttr. and *Cryphalus piceae* (Ratz.), that occurred suddenly over large areas of silver fir [*Abies alba*] in the Jura, the lower Alps and central Switzerland in the hot, dry summer of 1947. The control of *I. curvidens* and *I. spinidens* is complicated because the larvae enter the sapwood to pupate and infested trunks must be barked before they do so. Infested trees are then difficult to detect, for the yellowing of the crown, which is the characteristic symptom of infestation, frequently does not occur until later. No control of larvae, pupae or young adults in the sapwood was obtained when logs with the bark removed were dusted or sprayed with various insecticides, and it is recommended that control should consist of early detection of infestation, early barking (on sheets), and continuous removal of the infested trees to a distance of at least half-a-mile from the forest. Only very large trunks with thick bark are effective as trap-logs, those that are smaller or have smooth bark being ignored by the beetles. They should be felled and set out not later than the beginning of March, and a second series should be felled at the end of April in view of the protracted flight of the beetles. Barking should be accompanied by copious dusting of the infested parts of the trunk with benzene hexachloride.

KURIR (A.). **Die Massenvermehrungsgebiete der Nonne** (*Lymantria monacha* L.) **in Österreich von 1888–1947.** [The Outbreak Areas of the Nun Moth in Austria from 1888 to 1947.]—*Zbl. ges. Forst- u. Holzw.* **70** pt. 3–4 pp. 338–359, 1 map, 75 refs. Vienna [1948].

In connection with the outbreak of *Lymantria monacha* (L.) on spruce in the Styrian Alps in 1946–47 [*cf. R.A.E.*, A **38** 173–174, etc.], the author shows by means of a map and various lists the localities in Austria in which outbreaks of the moth have occurred since 1888. He briefly discusses the three chief outbreaks [*cf.* **36** 129] and finds from meteorological records that the districts concerned lie between the mean January isotherms of −2 and −6°C. [28·4–21·2°F.] and the July isotherms of 13 and 18°C. [55·4–64·4°F.], with a mean annual precipitation of from 500 to 1,600 mm. Outbreaks are usually confined to the lowlands, but the one in the valley of the Salza in 1946–47 began at a level of at least 160–330 ft. and the population of the moth was densest between 2,300 and 3,100 ft. Infestation extended in one district up to about 4,000 ft. [*cf.* **36** 129]. This unusual distribution is attributed to higher temperatures on the sides of the mountains than in the valley bottom, where cold air accumulates. The whole outbreak appeared to be due to unusually favourable conditions and a weakening of natural control by natural enemies and diseases.

SCHWERDTFEGER (F.). **Dürretrocknis.** [Drying up caused by Drought.] —*Forst u. Holz* 1948 no. 17 repr. [1] p. Hanover, 1948.

The author points out that the extensive mortality of spruce that began in the forests of north-western Germany in the autumn of 1947 and continued throughout the winter was due to drought in the preceding summer and not connected with the outbreaks of *Ips typographus* (L.) that were in progress in other areas [*cf. R.A.E.*, A **39** 32, etc.]. Young stands were the worst affected, and many of the dying trees were attacked by *I.* (*Pityogenes*) *chalcographus* (L.),

which spread from the crown to the trunk as the trees died back. Older dying trees were occasionally infested by *I. typographus*, but both bark-beetles were clearly secondary pests. Reasons are given for considering it unlikely that the increased breeding facilities would lead to an outbreak of *I. chalcographus* as a primary pest, but control measures are recommended since attack by it may prejudice the recovery of drought-affected trees.

HANF (M.). **Neue Erkenntnisse zur Bekämpfung des Apfelblütenstechers.** [New Findings in the Control of the Apple Blossom Weevil.]—*Anz. Schädlingsk.* **21** pt. 5 pp. 65–73, 4 figs., 4 refs. Berlin, 1948.

In view of a recent claim that control of *Anthonomus pomorum* (L.), which has become increasingly injurious to apple in Hesse, requires special spray applications that do not fit in with the normal spray schedule, the author reviews the results of experiments in various localities in the district of Giessen in 1947–48 indicating that this is not the case. Control must be applied after the migration of the overwintered weevils to the trees, which is dependent on temperature [*R.A.E.*, A **31** 436] and before they oviposit. The peak of migration usually occurs shortly before bud-burst, so that a late-dormant spray of dinitro-o-cresol, alone or with tar distillate (fruit-tree carbolineum), can be applied. The timing of this spray is important, and records for 1940–48 showed that the dates vary from year to year, the period available before bud-burst ranging from less than one to nearly three weeks. If, as occasionally happens, migration does not occur until after bud-burst, or spraying has to be deferred owing to unfavourable weather, a pre-blossom spray must be substituted. The best control was obtained when both were applied. In the various tests reported, lead arsenate and preparations of DDT and benzene hexachloride all proved effective in the pre-blossom spray.

Investigations on the importance of *A. pomorum* as a pest [*cf. R.A.E.*, A **25** 486 ; **27** 298, etc.] showed that the yield of apples from all varieties steadily diminished as the percentage of infested blossoms increased. The decrease was not regular for individual varieties, but some yielded no fruits when over 50 per cent. of the blossoms were infested.

SPEYER (W.). **Über die Wirkung von Pflanzenschutzmitteln auf Fische.** [On the Effect on Fish of Substances used for Plant Protection.]—*Z. PflKrankh.* **55** pt. 5–6 pp. 144–154, 16 refs. Ludwigsburg, 1948.

Since tar distillates and dinitro-o-cresol used in winter sprays on fruit trees are known to poison fish in water that becomes contaminated with them [*cf. R.A.E.*, A **27** 514, etc.], experiments were carried out in Germany in May 1944 in which young trout in glass vessels were subjected to the action of 19 insecticides and fungicides at 10–12°C. [50–53·6°F.]. The concentrations mostly used varied from 0·1 to 0·00001 per cent. Of the insecticides, tar distillates (emulsified or emulsifiable fruit-tree carbolineums [*cf.* **35** 70]) were the most toxic, whereas a petroleum-oil emulsion was considerably less dangerous at the lower concentrations. Derris (1 per cent. rotenone) was toxic at all concentrations, but nicotine, pyrethrum and quassin were harmless at the lower ones. Lead arsenate, calcium arsenate and zinc arsenate had no effect, and a DDT preparation (Gesarol) acted more slowly and was less toxic than was expected. In tests on the effects of the temperature of the water, a tar distillate at 0·0001 per cent. slowly killed all the fish at 7°C. [44·6°F.], whereas at 13–19°C. [55·4–66·2°F.] it was initially very toxic but then became less harmful, so that some of the fish recovered. All fish transferred to fresh water after 20 minutes in 0·001 per cent. tar distillate and most of those transferred after 1–2 hours recovered in two days, and it is concluded

that there is little risk to fish in running water, though there is a possibility of mortality in ponds.

FRANSEN (J. J.), BRAAT (C.) & TERPSTRA (P.). **Proeven en waarnemingen nopens de bestrijding van de sparrebladwesp** (*Lygaeonematus abietum* **Htg.) met chemische middelen.** [Experiments and Observations on the Control of *Pristiphora abietina* with Chemicals.]—*Tijdschr. PlZiekt.* **55** pt. 5 pp. 254–261, 26 refs. Wageningen, 1949. (With a Summary in English.)

In view of increasing damage to spruce in Holland by *Pristiphora abietina* (Christ) (*Lygaeonematus abietum* (Htg.)), laboratory and field tests were carried out to develop a suitable dust treatment for its control. In the laboratory, excellent results were given by pyrethrum dusts comprising at east 0·025 per cent. pyrethrins in talc when applied to the larvae. When larvae were placed on dusted branches, 60, 40 and 20 per cent. sodium fluosilicate gave 95, 85 and 70 per cent. dead and dying, and 60 and 40 per cent. barium fluosilicate 56 and 54 per cent., as compared with 45 per cent. in the controls ; both reduced feeding considerably. Gesarol dusts containing up to 0·5 per cent. DDT had little effect whether applied to the larvae, the branches to which they were subsequently transferred or both. In field tests in various localities, excellent results were given by 25 per cent. calcium cyanamide in dolomite, though 12·5 per cent. was rather less effective, 40 per cent. sodium fluosilicate in gypsum, which proved more effective than in the laboratory, possibly owing to a contact action on dusted larvae, 0·025 per cent. pyrethrins in talc, and Gesarol mixed with talc to give 0·5 per cent. DDT, but derris dusts gave doubtful results and it appeared that a rotenone content of at least 0·25 per cent. would be necessary.

In practical control work, calcium cyanamide alone or mixed with dolomite (1 : 1) sometimes caused considerable scorching of the trees, and 40 per cent. sodium fluosilicate was also very injurious. Pending further tests with DDT, the only material recommended is pyrethrum.

MELTZER (J.) & URI (J.). **Bestrijdingsproeven met Bentox en andere HCH-praeparaten tegen de champignonvlieg** (*Sciara* **spec.) in de grotten van de St. Pietersberg.** [Experiments with Bentox and other BHC Insecticides against the Mushroom Fly (*Sciara* sp.) in the St. Pietersberg Grottoes.]—*Tijdschr. PlZiekt.* **55** pt. 6 pp. 279–285. Wageningen, 1949. (Also in English pp. 285–289.)

Experiments with BHC (benzene hexachloride) against *Sciara* in mushroom beds in a series of caves near Maastricht were begun in 1948. In the first test, BHC in gypsum was mixed with the manure in various proportions before the soil was disinfected with formalin and the beds laid, but little or no control resulted, and this was apparently due to the habits of the fly. It had been thought that the females lay their eggs in the manure near the mycelium or in the mycelium itself, and that the larvae live in the mycelium in the manure, but it appeared more probable that they oviposit in the cracks in the soil layer covering the manure through which the growing mushrooms appear, and that the larvae do not occur in the manure or the lower layers of mycelium [*cf. R.A.E.*, A **21** 489 ; **22** 513 ; **35** 104], but bore directly into young mushrooms.

In the subsequent experiments, dusts were applied to the beds. In the first of these, 0·1 per cent. γ BHC in dolomite was applied at nearly 0·2 oz. per sq. yard, and this reduced the percentage of mushrooms damaged by *Sciara* from 90 for no treatment or dolomite alone to 5 at the first picking and also controlled Collembola. Similar results were obtained at the second and third

pickings, at which it was found that the treated beds considerably outyielded the controls. In the second test, in which the temperature was high (22°C. [71·6°F.]), the same treatment was compared with a spray of 0·03 per cent. nicotine followed by one of DDT ; nicotine was applied before the beds were covered with an upper layer of earth, and the other treatments after. There was insignificant infestation by *Sciara*, even in the controls, and it was suspected that the treatments had completely destroyed the populations of flies originally present by their fumigant effects, which would be favoured by the high temperature. In the third, two of five beds that had been sprayed with nicotine before they were covered with earth were dusted at about the same rate with 1 per cent. total BHC (as Bentox) in dolomite ; the dust blanketed the whole space. Again, no infestation resulted, and no Collembola or *Sciara* adults were observed on any of the beds, which supported the fumigation theory.

The final test was carried out on the beds originally used for the manure treatment, which had become very heavily infested by *Sciara*, up to 70 per cent. of the mushrooms being damaged. They were dusted with 3 per cent. total BHC in dolomite at 0·075 oz. per sq. yard. After five days, the percentage infestation had fallen to 31·25 per cent. by weight of mushrooms, and the dust was then applied twice during the following week. By the end of it, the pest was under complete control, and no infestation was observed thereafter. BHC had no effect on the quality, taste or smell of the mushrooms in any of the tests.

CHIN (Chun-teh). **Studies on the physiological Relations between the Larvae of *Leptinotarsa decemlineata* Say and some solanaceous Plants.**—*Tijdschr. PlZiekt.* **56** pt. 1 pp. 1–88, 2 pls., 27 figs., 5 pp. refs. Wageningen, 1950. (With a Summary in Dutch.)

The investigations described were carried out in the laboratory in Holland in 1948 and 1949 to clarify certain aspects of the feeding habits of the larvae of *Leptinotarsa decemlineata* (Say). The results, which are compared with the literature, are discussed with reference to food range and feeding habits, the sensory mechanisms involved in the selection of food-plants, the influence of food-plants on larval mortality and growth, the digestion of different plants and their effect on the digestive tract and on heart-beat, respiration and metabolism. The following is taken from the author's summary of the work.

The larva of *L. decemlineata* has a restricted food range confined to some of the Solanaceae. Plants of this family show a continuous gradation from those preferred to those rejected [*cf. R.A.E.*, A **34** 264]. The rate of feeding increased with rising temperature and reached a maximum at about 32°C. [89·6°F.], above which it decreased. The effective distance at which the larva can perceive a food-plant was about 2 mm. The odours of the plants were the most important factor for eliciting the biting response. The water vapour tension and the texture of the substratum played a minor part. The physiological conditions of the larva generally influenced the threshold of the stimuli. The gustatory properties of the leaf seemed to be the decisive element in continuing or discontinuing the feeding action. It is very probable that quantitative and qualitative differences in the " taste " substances in different plants are the principal cause of the feeding preference, which is manifested in the frequency and total duration of the feeding process and the extent of food consumption. Under laboratory conditions, the relative lengths of the periods of feeding, resting and wandering, which can be used as a criterion for food preference, are determined by sensory reactions.

Petunia hybrida was definitely toxic to the larva ; the third and fourth instars, which possess the greatest tolerance, survived on this plant for only

four days. Under the experimental conditions, about 20 per cent. of the newly hatched larvae grew and matured on a resistant line of *Solanum demissum* [*cf.* **27** 107]. The mortality rate of the larvae feeding on *Atropa belladonna* was about 50 per cent. The adverse effect of this species was most conspicuous in the first larval instar. A large percentage of the larvae feeding alternately on potato and *S. demissum* reached maturity, but none did so when *Petunia hybrida* was used instead of *S. demissum*. In the thermal range suitable for development, the adverse effect of *S. demissum* was enhanced by lower temperatures.

With increase in body weight as the criterion, the larva feeding on potato possessed an S-shaped growth curve. Growth was very rapid in the third and the early part of the fourth instars, when the process of fat synthesis prevails. The growth curve of the larva feeding on *A. belladonna* was similar except for slower growth in the first instar. The larva feeding on *S. demissum* may also show the S-shaped growth curve, but this is usually marked by an inconsistent rate of growth. In these experiments, the larvae uniformly had four instars ; irregular and additional moults did not appear, even if the diet was unsatisfactory. The larval instars on unsuitable plants were generally prolonged. On *A. belladonna*, only the first instar was lengthened, the others being normal. On *S. demissum* the instars were progressively prolonged [*cf.* **27** 107], indicating that the adverse effect of this plant is different in nature from that of *A. belladonna*. On a suitable food-plant, the linear growth of the head capsule and mandibles is in close accordance with Dyar's rule. The later instars of the larvae feeding on *S. demissum* showed a defective linear growth of the parts mentioned. During growth, carbohydrates seemed to be the essential substances utilised in the body of the larva. Under conditions of malnutrition and starvation, fats and proteins were utilised for energy production, as shown in the decrease in the respiratory quotient.

The resistant lines of *S. demissum* were characterised by being attractive to the olfactory senses, repellent to the gustatory senses and deficient in nutritive properties for the feeding of the larva. An acute toxic effect could not be found [*cf.* **31** 370], though a slow chronic effect may not be excluded. The adverse effect of these plants on the larva is very similar to that due to inanition.

HIDDINK (G. J.). **De wintervlinder in het seizoen 1948–1949.** [The Winter Moth in the Season of 1948–49.]—*Tijdschr. PlZiekt.* **56** pt. 1 pp. 91–95, 2 graphs. Wageningen, 1950. (With a Summary in English.)

Observations on *Operophtera* (*Cheimatobia*) *brumata* (L.) were made in the winter of 1948–49 in an apple orchard in Holland in which some damage was done by the larvae each spring despite the use of lead arsenate sprays, grease-bands and winter sprays. They showed that the largest numbers of moths were taken on the bands in mid-November and none after the end of December, that the females preferred the southern sides of the stems, and that small proportions of them were able to cross the bands. There were differences in the numbers taken on trees of different varieties, and some activity occurred in the day-time in misty weather.

SAALTINK (G. J.). **Een virusziekte in stoppelknollen.** [A Virus Disease of Turnips.]—*Tijdschr. PlZiekt.* **56** pt. 1 pp. 95–98, 2 figs., 5 refs. Wageningen, 1950. (With a Summary in English.)

A description is given of the symptoms of a virus disease of turnips that was observed in Holland for the first time in the autumn of 1949. It spread outwards from pockets of infected plants in the field, and its appearance coincided

with a period of warm weather during which Aphids were numerous. It appeared to be identical with the mosaic disease of turnips reported from other countries [*cf. R.A.E.*, A **25** 260 ; **27** 273 ; **34** 182], which is transmitted by *Myzus persicae* (Sulz.) and *Brevicoryne brassicae* (L.).

KUENEN (D. J.). **The Fruit Tree Red Spider (*Metatetranychus ulmi* Koch, Tetranychidae, Acari) and its Relation to its Host Plant.**—*Tidjschr. Ent.* **91** (1948) pp. 83–102, 15 figs., 12 refs. Amsterdam, 1949.

The following is virtually the author's summary of this paper, which is based on observations on apple and plum begun in Holland in 1941. Certain aspects of the influence of food on the epidemiology of *Paratetranychus pilosus* (C. & F.) (*Metatetranychus ulmi* auct.) were investigated as part of a general study on its biology and control. The damage done to the leaf consists in perforation of the epidermis and ingestion of the contents of the parenchyma cells. Only feeding at the upper surface of the leaf gives rise to the well-known bronzing, the cells of the sponge parenchyma not showing any discoloration when punctured. The mites live on the lower surface of the leaf and come to the upper surface only when the temperature is high. This may be because the upper cuticle is thicker and cannot be pierced easily unless it is softened through higher temperature. Consequently a large population may be present for a considerable time without the bronzing of the leaves becoming apparent, whereas a few days of hot weather will bring the mites to the upper surface and result in the sudden appearance of extensive discoloration.

A study of the population dynamics showed that if the leaves become bronzed, the mites migrate to the branches earlier, and deposit fewer winter eggs, than they do otherwise. Consequently, few winter eggs are found after a heavy infestation, whereas they are produced in very large numbers by a population of medium density which does not overeat its food-supply. Trees attacked by fungous diseases, and possibly also those on which Aphids are abundant, have a much smaller red-spider population than healthy trees. Egg production is much greater on trees in good condition than in neglected orchards. This difference may explain the much more vigorous development of the mite in a well-kept orchard, though other factors cannot, for the present, be ruled out. The size of the population is influenced by the variety of tree on which it occurs and, to a less degree, by the root stock on which the tree is grafted. There is a correlation between the thinness of the leaf-cuticle and susceptibility to infestation.

BEAMENT (J. W. L.). **The Structure and Formation of the Egg of the Fruit Tree Red Spider Mite, *Metatetranychus ulmi* Koch.**—*Ann. appl. Biol.* **38** no. 1 pp. 1–24, 8 figs., 26 refs. London, 1951.

The following is almost entirely the author's summary. The summer egg and the overwintering diapausing egg of *Paratetranychus pilosus* (C. & F.) (*Metatetranychus ulmi* auct.) are described in detail ; there is no reliable method of distinguishing them on inspection. Both types of egg have a common basic shell structure, consisting of an outer thick wax layer of very high melting point and a cement layer of oil and protein, which attaches the wax to the underlying "shell" layer enclosing the living material. The shell layer is extremely resistant to penetration and to attack by chemicals or solvents ; it appears to be composed of a material similar to keratin. This layer is formed in the ovary, towards the end of yolk accumulation. The egg is apparently fertilised precociously, and there are no associated nurse or follicle cells ; only one egg is matured at a time.

The female reproductive system is described in some detail ; the egg receives its shell layer in the simple sac-like ovary, and then passes into a glandular ovipositing pouch, which is evaginated through the genital aperture at oviposition. The shell layer makes contact with the substrate, and the pouch secretes the cement over the rest of the shell layer so that the egg adheres to the substrate by a ring of cement around the base. The outer wax is then secreted over the cement, and it also leaves a large hole at the base of the egg, bordered by the cement. The female leaves the egg by rotating into an almost vertical position. In this process the ovipositing pouch is drawn off the egg, and withdrawn into the female ; consequently, the wax, which is plastic when first secreted, is drawn up into the characteristic spike that surmounts the egg. The spike is of no further physiological significance to the egg.

Owing to the hole in the egg-coverings at the base, the shell structure is not waterproof. The developing organism waterproofs the summer egg by secreting a wax layer into the inside of the shell about six hours after it is laid, previous to which the egg will only survive at relative humidities greater than 85 per cent. After waterproofing, the egg readily develops at humidities of 30 per cent. The waterproofing wax has a transition point of 68°C. The shell of the winter egg is similarly composed and waterproofed, but winter eggs are held up in the female until a later stage of embryonic development, so that they are waterproofed when they are deposited on the bark.

Some discussion is made of the importance of leaf and bark humidities in relation to the different times at which summer and winter eggs are waterproofed.

Kennedy (J. S.) & Booth (C. O.). **Host Alternation in *Aphis fabae* Scop. I. Feeding Preferences and Fecundity in Relation to the Age and Kind of Leaves.**—*Ann. appl. Biol.* **38** no. 1 pp. 25–64, 7 figs., 22 refs. London, 1951.

The following is based on the authors' summary. The feeding preferences and comparative fecundity of laboratory-bred, alate alienicolae of *Aphis fabae* Scop. were investigated in small leaf cages on leaves of spindle (*Euonymus europaeus*) and sugar-beet, representing a winter and a summer food-plant, respectively, both in pots in the greenhouse and growing naturally out of doors at Cambridge. The readiness of the Aphids to stay and feed and their average reproduction rate both varied between leaves of different ages and kinds, and there was evidence of true fecundity differences on different leaves. As a general rule, readiness to settle and reproduction rate varied together, but they did so significantly less often in comparisons between leaves of spindle and sugar-beet than in comparisons between leaves of the same species. On the whole, the Aphids preferred to feed and reproduced faster on young and early senescent leaves than on mature ones of the same species [*cf. R.A.E.*, A **39** 80]. To a limited extent, this rule seemed to govern also their comparative readiness to settle and reproduce when presented with leaves of the two different kinds of plant. On leaves of the same age, they settled and reproduced better on spindle than on beet. Since the Aphids used were alienicolae, this tends to confirm the usual designation of the winter food-plant as primary and the summer food-plants as secondary, for a given Aphid species.

These findings form the basis of a dual discrimination theory of food-plant selection, which assumes that Aphids respond in behaviour to at least two main classes of leaf property, one associated with the age of the leaf and the other with the kind of plant. It is suggested that in nature these two sensory requirements of the Aphids may be essentially contradictory, and that the shifting patterns of Aphid distribution among leaves and plants may depend on the shifting distribution of leaves offering a satisfactory compromise between them. The phenomenon of food-plant alternation is considered in the light of

the dual discrimination theory as a particular instance of a shifting distribution-pattern probably concerned with the alternation of the seasons of active growth and senescence in the winter and summer food-plants.

Ibbotson (A.) & Kennedy (J. S.). **Aggregation in *Aphis fabae* Scop. I. Aggregation on Plants.**—*Ann. appl. Biol.* **38** no. 1 pp. 65–78, 3 figs., 12 refs. London, 1951.

The following is virtually the authors' summary. A study at Cambridge of free infestations of *Aphis fabae* Scop. on the leaves of its food-plants, spindle [*Euonymus europaeus*] and sugar-beet, showed that the clustered distribution of the Aphids within the boundaries of each leaf was not a matter of chance, but involved active aggregations. Experiments in small leaf cages showed that aggregation could take place independently of any differences between portions of a leaf, being brought about by truly gregarious reactions between the Aphids. Experiments in which walking Aphids were made to encounter live or dummy Aphids fixed to leaves showed that the gregarious reactions were of at least two kinds. The Aphids both probed more often and remained with their mouth-parts inserted for longer when near other Aphids than when apart from them.

It appears that the unequal distribution of Aphids among the leaves of a plant is due primarily to intrinsic differences between leaves [*cf.* preceding abstract], but is aided by gregariousness, while the aggregations observed on leaves are due primarily to gregariousness and only secondarily to differences between portions of a leaf. It is suggested that the primary function of gregariousness is to concentrate the Aphids on the best feeding sites, both among the parts of a plant and among whole plants ; that is, it acts as an aid in food-plant selection, even with Aphids that do not aggregate so compactly as *A. fabae*. The functions of compact aggregations and other specialised forms of gregarious behaviour remain to be discovered.

David (W. A. L.) & Gardiner (B. O. C.). **Investigations on the systemic insecticidal Action of Sodium Fluoroacetate and of three Phosphorus Compounds on *Aphis fabae* Scop.**—*Ann. appl. Biol.* **38** no. 1 pp. 91–110, 5 figs., 23 refs. London, 1951.

The insecticides used in these studies were highly purified samples of diethyl p-nitrophenyl phosphate [paraoxon], bis (bis-dimethylamino phosphonous) anhydride [schradan], bis (dimethylamino) fluorophosphine oxide, and sodium fluoroacetate, of which the last two are referred to as the oxide and acetate, respectively, and the test insect was *Aphis fabae* Scop. on broad beans. The three phosphorus compounds are liquids and the acetate is a solid, all except paraoxon are very soluble in water, and all are very toxic to mammals. In experiments in which infested plants or leaves were dipped into solutions containing these materials at various concentrations and a wetter paraoxon, and the acetate gave complete mortality of the Aphids in one day at concentrations of 0·001 and 0·005 per cent., respectively, and schradan and the oxide in three days at 0·05 per cent. This mortality is attributed to contact action, but the possibility that the materials are absorbed by the leaves and the Aphids killed by imbibing toxic sap is not excluded. The persistence of toxic effect was investigated by reinfesting the plants as they became free from Aphids. When compared at the lowest concentrations that gave complete mortality, schradan was the most persistent. Paraoxon was the most toxic to the plants.

In experiments on systemic action [*cf. R.A.E.*, A **37** 487, etc.] in which solutions were watered on to sand or soil in 3½-inch pots in which young infested

plants were growing, the acetate gave complete mortality in 4–6 days at 0·001 gm. in 20 cc. water, as did the oxide at 0·01 cc. Schradan required 5–12 days at 0·02 cc. in 20 cc. water, and paraoxon had not killed all in ten days at 0·04 cc. in 40 cc. water. Other tests with schradan applied in this way, however, showed that there was some seasonal effect on toxicity. In a similar experiment in which plants were kept with their roots in toxic solution until they had absorbed 100 or 15–30 cc. after which some were transferred to culture solution and the rest left in the toxic solution, which was renewed every five days, the order of toxicity was about the same, except that paraoxon was as effective as schradan. At the lowest effective concentrations, the oxide and paraoxon were less persistent and more injurious to the plants than the acetate and schradan. The difference between the dosage that was necessary for insecticidal action and the dosage that injured the plants was greatest in the case of the acetate. In order to reduce errors introduced by possible selective absorption of the toxic solutions, the tap-roots of plants were cut and placed in tubes containing 1 cc. toxic solution, the other roots being in nutrient solution. Under these conditions, the dose was completely absorbed in a few hours in sunny weather. The approximate concentrations of acetate, oxide, paraoxon and schradan required to give complete mortality were then 1, 6, 30 and 50 mg. per kg. plant tissue, respectively. A further test showed that intact roots appeared able to absorb all the compounds, with the possible exception of paraoxon.

In order to determine whether the toxic solutions exert a systemic effect when applied to leaves, pairs of the lower leaves of infested plants were dipped in small volumes of the different solutions ; Aphids on the upper parts of the plants were killed only by treatment with acetate. When the solutions were dripped over a leaf several times a day, 50 cc. being applied on each occasion and the leaf being allowed to dry between each application, all the Aphids on plants that received the acetate at a concentration of 0·01 per cent. were killed in five days and evidence of systemic action was also obtained in one of four tests with schradan at 0·1 per cent. The Aphids on the lower surface of leaves treated with paraoxon at 0·01 and 0·1 per cent. were killed, but neither this material nor the oxide produced any systemic effect.

In tests of fumigant action, infested leaves were enclosed with filter paper treated with the solutions or with leaves from plants that had been standing in solutions. Only Aphids that were exposed to the oxide were killed, and further evidence of the fumigant action of this material was provided by tests in which half of an infested leaf growing on a plant was enclosed with a leaf from another plant that had been treated with the oxide, and the lower aerial parts of an infested plant growing in culture solution were enclosed with a plant growing in a solution containing 0·05 per cent. oxide. The vapour given off by plants growing in a solution of the oxide was collected by condensation and shown to be toxic to Aphids. No evidence was obtained of its conversion to a still more toxic compound within the plant.

Although the acetate is extremely effective as a systemic insecticide, whether applied to the leaves or roots of broad beans, and appears not to injure the plants at several times the concentration necessary for insecticidal action, it may prove to be too generally toxic or persistent for general use.

Woodcock (D.) & Stringer (A.). **The Insecticidal Activity of Parathion, its Isomers and some related Compounds.**—*Ann. appl. Biol.* **38** no. 1 pp. 111–120, 1 fig., 9 refs. London, 1951.

In view of the possible influence that the presence of isomers produced by heating may have on the toxicity of parathion (O,O-diethyl-O-p-nitrophenyl-thiophosphate) as a contact and stomach insecticide, the effect of such treatment

on the contact toxicity of deposits on filter paper was investigated, using *Calandra granaria* (L.) as the test insect. Treatment at about 140°C. [284°F.] resulted in isomerisation, followed by thermal decomposition and, when continued for 24 hours, complete loss of toxicity. The thiono-sulphur values, calculated as diethyl-p-nitrophenylthiophosphate, of samples that were heated for 0, 1, 7 and 24 hours were 81, 75·8, 43·7 and 0 per cent., respectively, and these were closely related to the corresponding relative toxicities of 1 : 0·92 : 0·43 : 0. Similar results were obtained when O,O-dimethyl-O-p-nitrophenylthiophosphate was heated. Paraoxon (diethyl-p-nitrophenyl-phosphate) and the two isomers of parathion, O,S-diethyl-O-p-nitrophenylthio-phosphate and O,O-diethyl-S-p-nitrophenylthiophosphate, all possessed considerable contact action, but were less toxic than parathion ; O,O-dimethyl-O-p-nitrophenylthiophosphate was considerably more toxic than parathion, but it is known to possess strong fumigant action, which could not be suppressed under the experimental conditions. The chlorinated compound, O,O-di-2-chloroethyl-O-p-nitrophenylthiophosphate, was considerably less toxic than parathion and appeared to have a different mode of action. Triethyl thiophosphate and O-ethyl-bis-O-p-nitrophenylthiophosphate, both of which may be present in commercial preparations of parathion, and S-ethyl-bis-O-p-nitrophenylthio-phosphate, which is obtained from the latter on heating, were ineffective as contact insecticides.

It is concluded that in the series of compounds examined, replacement of the group P=S by P=O or alteration in the size of the groups attached to the central phosphorus atom caused a reduction of insecticidal activity.

JAMESON (H. R.), THOMAS (F. J. D.) & TANNER (C. C.). **The Control of Wireworm by Gamma Benzene Hexachloride : the Development of a Seed Dressing for Cereals.**—*Ann. appl. Biol.* **38** no. 1 pp. 121–134, 8 figs., 1 ref. London, 1951.

Following the finding reported in a paper already noticed [*R.A.E.*, A **37** 231] that a seed dressing including 8 per cent. γ BHC (benzene hexachloride) showed promise in protecting oats from wireworm attack when used at the impracticable rate of 5 oz. per bushel, further investigations resulted in the development of dressings satisfactory when applied to oats or wheat at the normal rate of 2 oz. per bushel. They contained almost pure γ BHC and also an organomercurial at a concentration of 1 per cent. mercury. Preliminary tests showed that where wireworm attack was moderate or heavy, the optimum concentration of γ BHC was within the range of 10–35 per cent. In tests on spring oats in southern England in 1947 with dressings containing 10–35 per cent. γ BHC, maximum plant density was obtained from seed treated with 20–25 per cent. γ BHC where attack was light, but where it was heavy, plant density varied directly with the concentration ; in general, yields of grain and straw also increased significantly with concentration of γ BHC. Further tests were made during 1947–48 with autumn and spring wheat and spring oats, using γ BHC at concentrations of 10–30 per cent. Yields of straw and grain again increased significantly with concentration of γ BHC, except in the case of spring wheat, where the yield of straw, and also plant density, reached a maximum among plants from seed treated with about 25 per cent. γ BHC. Evidence of a persistent effect of the dressing was provided by untreated oats sown in the spring of 1948 on land that had been sown with treated seed a year earlier ; the yields of straw and grain in 1948 both showed a significant correlation with the concentrations of γ BHC applied in 1947.

In order to test the phytotoxic effect of the dressing under different conditions of soil and climate, it was used at concentrations of 20–70 per cent. γ BHC on winter oats and wheat sown in different parts of England during 1947–48

in fields where wireworms were scarce or absent. Concentrations of 20–30 per cent. γ BHC slightly retarded the appearance of the seedlings above ground, especially where they were growing rapidly, but the effect disappeared after a few days ; at 70 per cent., growth was seriously retarded. The dressing had no deleterious effect on plants that were growing slowly. Yields of grain were not significantly reduced even by 70 per cent. γ BHC, and in two trials they showed a slight, but significant, increase with increasing concentration ; yields of straw showed a similar trend.

In laboratory tests of the effect of overdressing, germination of seed treated with 70 per cent. γ BHC at the normal rate or 35 per cent. at 4 oz. per bushel was delayed, but the ultimate density of the plants was not affected. Seed treated with 20 and 30 per cent. dressings germinated normally after storage for 12 months.

GALLAY (R.). **Stations fédérales d'essais viticoles, arboricoles et de chimie agricole, à Lausanne et à Pully, sous-station en Valais, Conthey-Sion. Rapport d'activité 1945.**—*Landw. Jb. Schweiz* **60** pt. 8 pp. 741–842. Berne, 1946. **Rapport d'activité 1946.**—*Op. cit.* **61** pt. 8–9 pp. 701–792. 1947. **Rapport d'activité 1947.**—*Op. cit.* **62** pt. 6–7 pp. 555–660, 3 graphs. 1948.

These reports contain sections (pp. 769–785, 729–736, 602–611) dealing with work on pests of vines and fruit trees in French Switzerland and the canton of Ticino in 1945, 1946 and 1947, respectively, some of which has already been noticed [*R.A.E.*, A **36** 296]. Emulsified solutions of DDT were more effective than suspensions in controlling *Clysiana* (*Clysia*) *ambiguella* (Hb.) and *Polychrosis botrana* (Schiff.) on vines in 1945 and 1946. Of the sprays tested in 1947, an emulsion containing 0·5 per cent. Gesarol concentrate (20 per cent. DDT) was the most effective against both the first and second generations, a single application against the first giving 90·5–98·4 per cent. control. A suspension of 0·2 per cent. Gesarol powder containing 50 per cent. DDT, with a wetting agent, was slightly superior against the first generation to one of 1 per cent. Gesarol powder containing 10 per cent. DDT, also with a wetting agent, and to a spray of 1 per cent. Nirosan [a proprietary preparation containing tetranitrocarbazole (**35** 145)], which were about equal in effectiveness ; the results against the second generation were inconclusive. In another experiment, emulsified solutions of DDT carefully directed on to the clusters of grapes gave control greatly superior to that obtained when the whole vine was sprayed ; there was no abnormal development of *Paratetranychus pilosus* (C. & F.) in either case [*cf.* **38** 299]. At two of the four places at which the tests were carried out, ripening was delayed by the application of emulsified solutions of DDT, and at one the grapes did not colour so well as those on untreated vines or on vines sprayed with suspensions of DDT or with Nirosan. Since it had been found that the spray of 2 per cent. lime-sulphur with a wetting agent recommended against *Phyllocoptes vitis* Nal. on vines was not always effective, further tests were made in 1945. These showed that 2 and 3 per cent. sprays of lime-sulphur (32° Bé.) did not give economic control, but that control was very satisfactory when the concentration was increased to 5 or 6 per cent., or when rotenone or nicotine was added to the 2 per cent. spray.

Proprietary preparations of DNC (dinitro-o-cresol) tested against overwintering larvae of *Hyponomeuta padellus* (L.) on plum in March 1946 varied in effectiveness, and tests in 1947 showed that the pH value of three effective ones was 6·4, whereas that of an ineffective one was 10·3 [*cf.* **33** 15 ; **36** 274]. When 1 per cent. iron sulphate was added to this preparation, in accordance with the manufacturer's directions, its pH value was decreased to 6·8–7·0

and it became as effective as the others. In tests against larvae of *Hoplocampa minuta* (Christ) and *H. flava* (L.) on plum in all three years, DDT was more effective when used as an emulsified solution than as a suspension. In 1947, suspension sprays containing 0·13 per cent. BHC (benzene hexachloride) or 0·14 per cent. polychlorocyclane sulphide [*cf.* **35** 313] gave almost complete control and were superior to an emulsified solution of the sulphide or one containing 0·1 per cent. DDT. In the same year, *H. brevis* (Klug), which had been of importance on pear in the Ticino, also caused appreciable losses in French Switzerland. In tests on its control, the suspensions of BHC and polychlorocyclane sulphide gave practically complete protection and were more effective than an emulsified solution of 0·1 per cent. DDT ; the sprays were applied after petal-fall, when some eggs had hatched and the young larvae present were in sub-cuticular galleries at the base of the pistil.

Comparative tests of BHC and DDT against *Anthonomus pomorum* (L.) on apple gave inconclusive results in 1946, but when they were repeated in 1947, a suspension of DDT applied at the green-tip stage, immediately before oviposition began, gave almost complete control and was superior to one of BHC or an emulsified solution of polychlorocyclane sulphide, which were about equally effective. When, however, the applications were made nine days later, after the buds had opened and egg-laying had begun, BHC still gave considerable control whereas DDT was useless. In tests against eggs of *Aphis* (*Doralis*) *pomi* Deg. on apple in 1945, sprays containing 1·5 or 2 per cent. DNC applied on 13th February or 12th March, when the trees were dormant, were equal and in some cases superior to tar distillates (4 per cent. normal carbolineum or 6 per cent. emulsified carbolineum [*cf.* **35** 70]) and a mixture of carbolineum and DNC was about as good. White oil at a concentration of 4 per cent. was of no value alone, but when it was combined with 1 per cent. DNC, control was as good as that given by 1·5 per cent. DNC ; this mixture is costly, but also controls *Paratetranychus pilosus*. None of these sprays damaged the trees, but when applied on 22nd March, after the buds had burst and hatching had begun, so that results could not be estimated, carbolineum and DNC both scorched the tips of the young leaves and the two mixtures seriously scorched the flower buds and destroyed some of them. Tests with all the commercial preparations of carbolineum, DNC and combinations of the two available in Switzerland in 1946, in which applications were made between 21st January and 27th March, indicated that normal soluble and emulsified carbolineums applied early or late were equally effective and in general very satisfactory against *A. pomi*, that DNC preparations were equal or in some cases slightly superior to them, and that the combined sprays give satisfactory control.

Work on the control of *Cydia* (*Laspeyresia*) *pomonella* (L.) was continued during the three years [*cf.* **35** 145]. Emulsified solutions of DDT [*cf.* **36** 296] were in general comparable with or superior to lead arsenate on apple and pear, but repeated applications caused great increases in numbers of *P. pilosus*, especially in Valais, and, in one case in 1945, of *Eriosoma lanigerum* (Hsm.), and sometimes damaged the leaves. In 1947, a DDT suspension was in some cases better than the emulsified solution. Experiments in 1946 and 1947 to test the value of adding brown sugar to sprays of lead arsenate [**36** 296] gave contradictory results and the practice is not considered justifiable under Swiss conditions. Emulsified solutions of DDT were very effective against *C. pomonella* on apricot in all three years. Following several hot, dry summers in which *P. pilosus* had increased considerably, experiments on its control were carried out on plum in 1945. An application of 3 per cent. winter oil on 19th March was of little value alone, but when it was followed by one of 1 per cent. lime-sulphur with a wetting agent on 11th May, infestation on 20th July was reduced by 91 per cent., as compared with no treatment. Single applications on 11th May

of 1 per cent. lime-sulphur with a wetting agent or with rotenone and of a proprietary preparation of rotenone in white oil gave 81, 84·5 and 99 per cent. control, respectively ; the rotenone preparation also kills the summer eggs, but is costly.

The campaign to prevent the establishment of *Quadraspidiotus perniciosus* (Comst.) in Switzerland, begun in 1946 [*cf.* **37** 64], was continued and intensified in 1947, when further local outbreaks, chiefly in the Ticino, were suppressed. Studies on the bionomics of the Coccid showed that it has two generations and a partial third during the year in southern Switzerland. The winter is passed in the first nymphal instar, and overwintering individuals generally belong to the third generation.

Kaussari (M.). *Pectinophora gossypiella.* [*In Persian.*]—*Ent. & Phytopath. appl.* no. 3 pp. *12–15.* Teheran, 1947. (With a Summary in French, p. 3.)

The author discusses the damage caused to cotton by *Platyedra* (*Pectinophora*) *gossypiella* (Saund.) in Persia [*cf. R.A.E.*, A **37** 10], and points out that although the larvae generally feed on the seeds in the bolls, they have been observed feeding in numbers on the flowers in Charbar. In southern Persia, during the summer, the hot winds kill malvaceous plants and make conditions for the development of the insect unfavourable ; this has greatly facilitated quarantine measures, which have prevented its spread and resulted in its extermination in the area in which they have been applied [*loc. cit.*]. The author also discusses various measures that are being taken to prevent fresh introductions of *P. gossypiella.*

Kiriukhin (G.). *Prospaltella* **sp. (Hym. Chalcididae-Aphelinidae) parasite de** *Lepidosaphes beckii.* [*In Persian.*]—*Ent. & Phytopath. appl.* no. 3 pp. *16–18,* 1 fig., 2 refs. Teheran, 1947. (With a Summary in French, pp. 4–5.)

The author describes the adult, larva and pupa of an unidentified species of *Prospaltella* that was found in three places in northern Persia, where it parasitised 95 and 80 per cent. of *Lepidosaphes beckii* (Newm.) and *Aonidiella citrina* (Coq.), respectively, on *Citrus* and 50 per cent. of *Hemiberlesia rapax* (Comst.) (*camelliae* auct.) on *Buxus.*

Kiriukhin (G.) & Taghi-Zadeh (F.). **Les coccides du genre** *Aonidiella* **dans les régions subtropicales du Nord de l'Iran.** [*In Persian.*]—*Ent. & Phytopath. appl.* no 3 pp. *40–43,* 1 fig., 3 refs. Teheran, 1947. (With a Summary in French, p. 19.)

Aonidiella aurantii (Mask). and *A. citrina* (Coq.) are both present on *Citrus* in northern Persia. *A. aurantii* was accidentally introduced from Palestine [*R.A.E.*, A **36** 387] and occurs along the Caspian coast from Ramsar to Bandar-Pehlevi, while *A. citrina* was first observed at Bandar-Pehlevi. The characters of these two species and *Chrysomphalus dictyospermi* (Morg.) are compared in a table.

Kiriukhin (G.). **Les cochenilles farineuses et leurs parasites en Iran (sous-famille : Pseudococcinae).** [*In Persian.*]—*Ent. & Phytopath. appl.* no. 4 pp. *17–33,* 16 figs. Teheran, 1947. (With a Summary in French, pp. 6–11.)

The author reviews the habits and control of mealybugs and gives a list of eight species that have been observed on cultivated plants in northern Persia, with notes on adult morphology and distribution. They are *Pseudococcus adonidum* (L.), which occurs in greenhouses, *P. maritimus* (Ehrh.), *P. citri*

(Risso), *P. filamentosus* (Ckll.) and *Phenacoccus aceris* (Sign.), which are polyphagous and are recorded on a variety of trees and shrubs ; a species considered to be *Pseudococcus comstocki* (Kuw.), which was observed in 1945 on an ash tree (*Fraxinus oxycarpa*) in the yard of a seed merchant and was then destroyed ; *Trionymus amaryllidis* (Bch.), which has been found on *Amaryllis* ; and *Gossyparia spuria* (Mod.), which occurs on elm and *Fraxinus* and is of no economic importance. The mealybugs are destroyed by Coccinellids, including two species of *Scymnus* that are predacious on eggs and nymphs, have 3–4 generations a year and are parasitised in the larval stage by *Homalotylus* sp., by the Lygaeid, *Piocoris luridus* (Fieb.), which attacks the adults and nymphs at night and hides in cracks by day, and by parasites. *Anagyrus schönherri* (Westw.), the adults of which are described, is the principal parasite and gives important control of *Pseudococcus citri* and *Phenacoccus aceris*, especially when both species occur together, though 60 per cent. of the parasitised females lay 25 per cent. of their eggs, so that control is never complete. The introduction of *Cryptolaemus montrouzieri* Muls. is suggested.

KAUSSARI (M.). *Earias insulana* **Boisd.** [*In Persian.*]—*Ent. & Phytopath. appl.* no 4 pp. *34–47*, 4 figs. Teheran, 1947. (With a Summary in French, pp. 12–14.)

Earias insulana (Boisd.), the feeding habits of which are described, is widely distributed on cotton in Persia [*cf. R.A.E.*, A **17** 125] and particularly injurious where the climate is hottest. The cotton is sown at the end of March, and the first bolls are produced at the beginning of summer. Observations in Khuzistan have shown that infestation by *E. insulana* begins in May and that about 14 per cent. of the bolls are attacked by the beginning of June. After this the intense summer heat arrests the growth of the crop and results in a heavy fall of bolls, but the pest population increases when flowering is resumed at the beginning of autumn and damage is severe. In 1935–36, the crops at one place were completely destroyed by the heat and the infestation.

As a result of trials in this area, the author recommends that sowing should be delayed until the end of summer. The bolls are then produced in late winter and early spring and harvest is complete before the next summer. Yield is satisfactory and spring infestation by *Earias* light. Good cultural conditions and the use of early varieties are beneficial. Collecting the damaged bolls is of little value for control, since of 335 that had been infested, only 85 contained living larvae. Light-traps are also unsatisfactory, since they attract large numbers of parasites. Insecticides that can be used against *Earias* are briefly reviewed. *Bracon* (*Microbracon*) *brevicornis* Wesm. has been observed parasitising *E. insulana* in Khuzistan and Kerman, but attempts to rear it in the laboratory were not encouraging, since after several generations nearly all the individuals obtained were males.

KIRIUKHIN (G.) & TAGHI-ZADEH (F.). **Les essais faits avec D.D.T. pour la lutte contre les insectes.** [*In Persian.*]—*Ent. & Phytopath. appl.* no. 4 pp. *58–66*, 1 fig. Teheran, 1947. (With a Summary in French, pp. 24–28.)

The results are reviewed of experiments with sprays and dusts of DDT begun in Persia in 1946. Against *Gnorimoschema* (*Phthorimaea*) *ocellatella* (Boyd) on beet, 0·1 per cent. DDT in a suspension and an emulsified solution gave 84 and 98 per cent. control in a week, as compared with 93 for 0·1 per cent. paris green and 95 for 0·5 per cent. nicotine sulphate. As a result of tests against pests of pistachio [*cf. R.A.E.*, A **36** 386], the treatments recommended are an emulsified solution of DDT applied at the end of March against the adults of *Idiocerus ståli* Fieb. before they oviposit and again after flowering

against the nymphs if the first treatment is not effective, and two applications of a DDT dust, the first timed to protect the trees from attack by newly emerged adults of *Hylesinus* (*Chaetoptelius*) *vestitus* (M. & R.) and the second to destroy *Psylla* sp. and other leaf-feeding insects. In tests on *Citrus*, 1 per cent. emulsions of oil containing 10 per cent. DDT gave high or complete mortality of *Chrysomphalus dictyospermi* (Morg.) and complete mortality of its parasite, *Aphytis chrysomphali* (Merc.), whereas a 1 per cent. emulsion of oil alone gave a much lower mortality of both insects.

Esfandiari (E.). **Les maladies des plantes cultivées et des arbres fruitiers des régions subtropicales du nord de l'Iran.** [*In Persian.*]—*Ent. & Phytopath. appl.* no. 5 pp. *1–21*, 14 figs., 7 refs. Teheran, 1947. (With a Summary in French, pp. 1–7.)

This paper on fungous diseases of cultivated plants and fruit trees in northern Persia includes a note on *Cephalosporium lecanii*, which, like *Fusarium juruanum* [*R.A.E.*, A **36** 386 ; **37** 11], attacks Coccids on *Citrus*. In addition to *Saissetia oleae* (Bern.) and *Pulvinaria aurantii* Ckll. [*cf.* **36** 385 ; **37** 11], it was found infesting *P. floccifera* (Westw.), *P. vitis* (L.) and *Ceroplastes sinensis* Del G. in several localities, and it gave almost complete mortality of all five Coccids at two of them.

Kiriukhin (G.). **Quelques Aleurododea de l'Iran.** [*In Persian.*]—*Ent. & Phytopath. appl.* no. 5 pp. *22–28*, 8 figs., 3 refs. Teheran, 1947. (With a Summary in French, pp. 8–10.)

Descriptions are given of the pupae of seven species of Aleurodids that occur on cultivated plants in Persia, with notes on their local distribution. They are of little or no economic importance, since they are kept under control by natural enemies, but include such well-known pests as *Bemisia tabaci* (Gennadius) (*gossypiperda* Misra & Lamba) on cotton and *Aleurocanthus woglumi* Ashby on *Citrus*, both in the south.

Davatchi (A.). *Locusta migratoria* **L. attaquant les régions nord de l'Iran.** [*In Persian.*]—*Ent. & Phytopath. appl.* no. 5 pp. *52–57*, 1 map. Teheran, 1947. (With a Summary in French, pp. 18–19.)

In the summers of 1946 and 1947, swarms of *Locusta migratoria migratoria* (L.) crossed the north-western border of Persia near the Caspian coast and flew in a south-easterly direction as far as Bandar-Pehlevi. Mortality was very heavy and no oviposition was observed in 1946, while the swarms in 1947 were small. These invasions were quite unusual, and it was presumed that the locusts had been carried into Persia by strong winds after oviposition had taken place.

Kiriukhin (G.). *Syngenaspis oleae* **Colvée, cochenille nuisible aux arbres fruitiers et ses parasites.** [*In Persian.*]—*Ent. & Phytopath. appl.* no. 6–7 pp. *69–76*, 3 figs. Teheran, 1948. (With a Summary in French, pp. 22–23.)

Parlatoria (*Syngenaspis*) *oleae* (Colv.) has long been established in Persia, where it attacks many ornamental plants and fruit trees, including persimmon, pomegranate, pear, apple, cherry, plum, almond, fig, loquat, olive and *Citrus*. It has three generations a year on the Caspian coast and two elsewhere, and hibernates in the second or third nymphal instar. It is preyed upon by the Coccinellids, *Coccinella septempunctata* L., *Chilocorus bipustulatus* (L.), and *Exochomus quadripustulatus* (L.), which occur throughout the country, and

E. flavipes (Thnb.), which occurs in the north and central provinces. These afford considerable control but are attacked by various parasites, of which the chief is *Tetrastichus epilachnae* (Giard). Parasites of the Coccid are of more importance and comprise the Encyrtids, *Aphytis chrysomphali* var. *mazandaranica* Kiriukhin, which is present in the north [*cf. R.A.E.*, A **37** 11], and *A. proclia* (Wlk.), which occurs in the central and southern regions and of which the adult is described. They sometimes give 95–100 per cent. mortality, which results in the disappearance of *P. oleae* for several years.

KAUSSARI (M.). *Gryllotalpa gryllotalpa* **L.** [*In Persian.*]—*Ent. & Phytopath, appl.* no. 6–7 pp. *79–87*. Teheran, 1948. (With a Summary in French. p. 25.)

Gryllotalpa gryllotalpa (L.), the adult of which is described, is injurious in seed-beds, gardens and vegetable plots in Persia and damages many plants, especially maize, tobacco, potatoes and flax. Other species present are *G. unispina* Sauss. and *G. africana* P. de B. Tests have shown that bran baits poisoned with benzene hexachloride are very effective for control if broadcast in the evening after watering.

FLECK (E. E.). **Residual Action of organic Insecticides.**—*Industr. Engng Chem.* **40** no. 4 pp. 706–708, 24 refs. Easton, Pa., 1948.

The residual action of an insecticide is determined by its vapour pressure, its adhesive power, its solubility, its absorption into the surface on which it is applied, and its resistance to chemical change. In this paper, the author reviews the chemical changes that are undergone by organic insecticides of low vapour pressure when exposed in thin layers to the action of sunlight, air and the materials with which they may come in contact while in use.

The high degree of unsaturation of the pyrethrins accounts for their instability, particularly in the presence of light and air. Investigations on the action of antipolymerisation and antioxidation agents to prolong the insecticidal action of pyrethrum powder showed that the addition of 3·3 per cent. hydroquinone or isopropyl cresol prevented detectable deterioration for 79 days, but that the dust lost its toxicity after exposure for a year [*cf. R.A.E.*, B **35** 39]. Solid rotenone is stable when not exposed to light, but direct sunlight catalyses its oxidation to form a mixture of dehydrorotenone and rotenonone, and oxidation takes place much more rapidly when the material is in solution ; solvents such as pyridine and chloroform accelerate oxidation more than benzene and alcohol. Under ordinary conditions of field application, rotenone dust retains its insecticidal effect for almost a week ; attempts have been made to prolong this period by the addition of antioxidants, but none has achieved general acceptance. Alkaline materials mixed with rotenone cause it to deteriorate even in the dark. Dihydrorotenone retains more of its toxicity than does rotenone during the first days of exposure to sunlight, but loses about as much after 20 days [A **21** 339]. The persistent effect of phenothiazine is largely limited by its instability in light and air, loss of toxicity being again associated with oxidation. This susceptibility of organic insecticides to oxidation in air and sunlight has led to the use of oxygen inhibitors, such as β-naphthol and hydroquinone, which materially lengthen the effective period of the insecticide, and control of oxidation has also been attempted by the addition of ultraviolet opacifiers, such as tetramethyldiaminobenzophenone and cerium oxalate.

DDT is very resistant to oxidation in air or in acid solution, but is readily dehydrochlorinated in alkaline solution to form an insecticidally inert compound. It is not dehydrochlorinated when in suspension with an alkali in water unless a mutual solvent is present, but some wetting agents provide the

mutual solubility needed for the reaction. DDT is also susceptible to catalytic dehydrochlorination in the presence of anhydrous ferric and aluminium chlorides, iron, rust, stainless steel and chromium [*cf.* A **34** 157]. This catalytic action is inhibited by most solvents, such as oils, fats, fatty acids and alcohols, but not by chlorinated or nitrated solvents, which permit catalytic action at ordinary temperatures ; the presence of water reduces the action, presumably by hydrating anhydrous chlorides. Reports vary greatly as to the duration of the persistence of DDT deposits under field conditions. The extent of decomposition of DDT in solution has been roughly correlated with the boiling point of the solvent [*cf.* A **35** 177–178]. Both technical and pure p,p′DDT are rather stable against strong irradiation with ultraviolet light when in the solid form but not when in solution [*cf.* A **38** 383]. Of the common solvents, benzene was found to facilitate decomposition under irradiation to the greatest extent and alcohol to the least. When DDT was irradiated in solution in different solvents and kept from the air, hydrochloric acid developed in each solution tested and crystalline products of higher melting point than DDT were isolated from some [*cf.* next abstract] ; benzene was also found to be the most active solvent under these conditions. It appears that ultraviolet light will either catalyse the condensation of DDT molecules or cause them to react with the solvent. DDT is difficult to remove from apple or orange peel [*cf.* A **36** 135] because it tends to dissolve in the wax or oil of the fruit ; the usual methods of washing to remove the residue are less effective with this compound than with inorganic materials, and it is apparent that DDT is too persistent for some agricultural uses.

Fleck (E. E.). **The Action of ultraviolet Light on DDT.**—*J. Amer. chem. Soc.* **71** pp. 1034–1036, 7 refs. Easton, Pa., 1949.

The following is the author's summary. It has been shown that ultraviolet light catalyses the decomposition of DDT [*cf.* preceding abstract]. One of the decomposition products is 4,4′-dichlorobenzophenone when air is present. In the absence of air, 2,3-dichloro-1,1,4,4-tetrakis-(p-chlorophenyl)-2-butene is formed. This compound, through loss of hydrogen chloride and subsequent oxidation, may be converted into 4,4′-dichlorobenzophenone.

Lord (K. A.). **The Sorption of DDT and its Analogues by Chitin.**—*Biochem. J.* **43** no. 1 pp. 72–78, 3 refs. Cambridge, 1948.

It has been suggested that the chitin of the insect cuticle serves to concentrate DDT selectively from the media with which the insects are treated and so gives a higher concentration inside them [*cf. R.A.E.*, A **39** 54]. If this is so, it is to be expected that the toxicity of compounds similar to DDT will be affected by the extent to which they are sorbed by chitin and that account must be taken of the degree of concentration of these substances in the insect by the sorptive action of the chitinous cuticle when their potencies are compared. Experiments were therefore carried out to determine the sorption of p,p′DDT, its p,p′-substituted fluorine, bromine, iodine and ethoxy analogues and the unsubstituted parent compound, 1,1,1-trichloro-2,2-diphenylethane, from colloidal suspensions. The chitin used was from lobster shell, and it was replaced in some tests by sand, cellulose or wool in order to obtain information on the method of sorption.

It was found that DDT and its analogues were readily sorbed by chitin, but not by cellulose, wool or silica powder. The rate of sorption depended on the concentration of the colloidal suspension, and the total amount sorbed by a given weight of chitin on the surface area of the chitin. The molecular amounts

of DDT and its analogues sorbed from suspensions of equimolecular concentrations, and apparently also the rate of sorption, were approximately equal and there was no significant correlation between the sorption of DDT analogues on chitin and their toxicity.

FLECK (E. E.). **The Preparation of α,α,α′-4,4′-Pentachlorobibenzyl, an Isomer of DDT.**—*J. Amer. chem. Soc.* **70** p. 2173, 10 refs. Easton, Pa., 1948.

Attempts have been made to correlate the insecticidal action of DDT and related compounds with the presence of the parachlorophenyl groups or the trichloromethyl group and with the ease with which hydrogen chloride is liberated from the molecule [*cf. R.A.E.*, A **35** 203, etc.]. It has been stated by Martin that although high toxicity was not found in all the DDT analogues that are readily dehydrohalogenated, all those that showed high toxicity dehydrohalogenated readily in dilute alcoholic alkali [*cf.* **34** 255 ; **36** 274–275]. In the investigation described, *dl*-α,α,α′,4,4′-pentachlorobibenzyl, a DDT isomer that resembles DDT in having two parachlorophenyl groups, a hydrolysable chlorine atom and sensitivity to the catalytic action of anhydrous ferric chloride, but in which both carbon atoms of the ethyl group are substituted with a parachlorophenyl group, was prepared, but it did not show toxicity when tested against house-flies [*Musca domestica* L.], Aphids, Lepidopterous larvae and Tetranychid mites. These results provide evidence that insecticidal action is due to the molecule as a whole rather than to the presence of toxic groups or specific reactions.

ROGERS (E. F.), KONIUSZY (F. R.), SHAVEL jr. (J.) & FOLKERS (K.). **Plant Insecticides. I. Ryanodine, a new Alkaloid from** *Ryania speciosa* **Vahl.**—*J. Amer. chem. Soc.* **70** pp. 3086–3088, 26 refs. Easton, Pa., 1948.

The authors describe a method of quantitative extraction of the insecticidal principles from the ground stem and root of *Ryania speciosa* by extracting with water or extracting with chloroform and transferring the active principles to water, after which the concentrated aqueous solution is extracted again with either ether or amyl acetate to remove the insecticidal principles. Ether or acetone solutions of the extractives gave a crude crystalline material, and repeated crystallisation of the product from ether resulted in a pure compound. This alkaloid has been designated ryanodine and is highly insecticidal, possessing approximately 700 times the potency of the stem wood of *R. speciosa*. Its properties and probable composition are discussed.

HALL (S. A.). **Report on Tetraethyl Pyrophosphate.**—*J. Ass. off. agric. Chem.* **33** no. 3 pp. 761–763, 2 refs. Washington, D.C., 1950.

Methods of analysis for tetraethyl pyrophosphate in insecticidal products are based on the selective hydrolysis of the sample, followed by a separation of the unhydrolysed tetraethyl pyrophosphate from acidic ethyl phosphates and polyphosphates [*cf. R.A.E.*, A **37** 487 ; **38** 156]. A modified method adapted for commercial formulations with and without organic solvents and emulsifiers is described and recommended for adoption.

BOWEN (C. V.). **Report on Benzene Hexachloride.**—*J. Ass. off. agric. Chem.* **33** no. 3 pp. 774–782, 21 refs. Washington, D.C., 1950.

The development of methods of analysis for BHC (benzene hexachloride) is complicated by the fact that there are five known isomers as well as small amounts of other chlorinated products of benzene present in the technical product ; since the γ isomer is much more toxic to insects than the other four,

analysis for the total BHC is of limited value. When residues or mixtures of BHC with other materials are examined, determination of the total compound may sometimes be adequate, but when the material is being assayed for insecticidal value it is essential to determine the proportion of γ isomer present.

Methods of calculating total BHC are based on the determination of total organic chlorine or of hydrolysed chlorine obtained on dehydrochlorination by an alkali [*cf. R.A.E.*, A **38** 403–404]. Analyses for γ BHC have been made by fractional extraction and selective precipitation, by the use of the infra-red spectrometer [*cf.* **38** 403], and by partition chromatography, using nitromethane and n-hexane as the partition solvents and silicic acid as the supporting solid of the column, and adding a dye to locate the position of the γ isomer as it moves down the column and thus reduce the number of fractions that it is necessary to collect. A cryoscopic method [*cf.* **39** 403] and polarographic and mass-isotope dilution methods have also been developed. The chemical behaviour of the isomers is so nearly the same that attempts to evolve chemical methods of analysis have not been fruitful. The only one that has been proposed is based on the differences in the rates of dehydrochlorination of the several isomers by alcoholic potassium hydroxide at 0°C.

In the investigations recorded, the infra-red analysis by spectrometric method and the partition chromatographic method gave very good and consistent results ; both are recommended for official adoption as alternatives for the determination of the γ isomer in technical BHC and the second also for its determination in wettable powders and dusts.

EDWARDS (F. I.). **Report on Parathion.**—*J. Ass. off. agric. Chem.* **33** no. 3 pp. 783–787, 12 refs. Washington, D.C., 1950.

The author reviews methods of analysis for parathion in technical parathion and its dust formulations, currently in use and under development. Those for technical parathion comprise colorimetric determination, polarographic determination, ultraviolet absorption for determining parathion vapours in air, a combination of titration and colour development, and distillation. Parathion is extracted from dusts by one of three methods described and then submitted to the same procedures. None of the methods is considered completely satisfactory, owing mainly to interference by impurities containing the nitro group, which leads to high results.

Notes are appended on a recent modification of the colorimetric method and a new one based on the determination of total and free paranitrophenol.

Progress Reports from Experiment Stations Season 1945–46.—[2+] 132 pp., 2 graphs, refs. London, Emp. Cott. Gr. Corp., 1947. **Season 1946–47.**—[2+] 152 pp., 6 figs., refs. 1948. **Season 1947–48.**—[2+] 137 pp., 2 figs., refs. 1949. **Season 1948–49.**—[2+] 172 pp., 5 graphs, refs. 1950. Price 3*s.* each.

The pests of cotton occurring at various Experiment Stations during the seasons of 1945–46, 1946–47, 1947–48 and 1948–49 are discussed as in previous years [*R.A.E.*, A **35** 339, etc.].

The first three of the reports from Queensland (pp. 1–9, 1–8 and 1–8, respectively) are by W. G. Wells and the last (pp. 166–171) by R. W. Peters. *Heliothis armigera* (Hb.) was of little importance in 1945–46, caused heavy local damage in the south in 1946–47 and was noticeably active in 1947–48. Experiments on its control wth dusts in 1945–46 indicated that one application of 2 per cent. DDT at the peak of infestation was more effective than one of 0·5 per cent. γ BHC (benzene hexachloride) or two of 90 per cent. lead arsenate ; in the next year, a spray containing 0·3 per cent. DDT was more effective than a 4 per

cent. DDT dust. In 1948–49, when infestation by *Heliothis* was light, four applications of 0·4 per cent. DDT spray between early November and mid-January gave a highly significant increase in yield at the first picking, but not even a significant one at the second. In 1947–48, populations of *Aphis gossypii* Glov. increased after applications of a dust of 90 per cent. lead arsenate and 0·3 per cent. nicotine or a spray of 0·4 per cent. DDT and populations of Tetranychid mites in rain-grown cotton on a poor soil increased considerably after spraying with DDT. In 1946–47, there was a widespread outbreak of *Loxostege affinitalis* (Led.), which invaded cotton in central and southern Queensland in November and caused heavy losses where control measures were not applied promptly. *Empoasca maculata* Evans was of little importance except where good rains occurred late in the season.

Several of the reports from Barberton, South Africa, include information on insects. In that on plant pathology in 1945–46 (pp. 20–31), G. M. Wickens reports that infestation by stainers (*Dysdercus*) was rather heavy and early in relation to crop development and resulted in much puncturing of bolls and some damage to the developing cotton, though staining was not extensive, while in an introductory note to that for 1947–48 (pp. 10–12), D. MacDonald states that attack by insects, particularly American bollworm (*H. armigera*) and Jassids, was heavier than in previous years and that *Sylepta derogata* (F.) was recorded on cotton for the first time in South Africa. In the report of the Entomological and Physiological Section for 1948–49 (pp. 26–32), R. C. Rainey describes the conditions suitable for the growth of cotton in South Africa. Along the coastal belt, in Natal and adjoining territories, production is limited by *Dysdercus nigrofasciatus* Stål in the south and by *D. nigrofasciatus*, *D. fasciatus* Sign., *D. intermedius* Dist. and the red bollworm, *Diparopsis castanea* Hmps., in the north. In the main South African cotton-growing areas, the more extreme temperatures often provide marginal conditions for *Dysdercus* egg development, even during the growing season, and it is suggested that stainers that appear at the beginning of the season in the main cotton-growing areas may be carried there by wind from the more equable coastal belt, where winter breeding occurs. The parasites of *Dysdercus* present are of little economic importance [*cf.* **36** 27].

The first part of the first report from Gatooma, Southern Rhodesia (pp. 33–48) and the reports for the second and third seasons (pp. 39–48 and 34–46) are by A. H. McKinstry, and that for the fourth (pp. 108–117) is by McKinstry & R. W. James. It is shown in the first of them that when cotton and maize are planted at the same time, the first infestation of cotton by *H. armigera* is probably mainly due to oviposition by adults that have been bred on the maize, though a few of the moths contributing to the main attack may be derived from the very early but light oviposition that takes place on cotton in its early flowering stages. Populations on cotton have been much smaller since 1940–41, when the growing of *Dolichos* was abandoned at the experiment station, but it is not known whether this relation is significant. *Diparopsis castanea* is the most injurious pest of cotton early in the season, when it causes considerable destruction of squares, and it continues to do important damage throughout the season, except when maximum populations of *H. armigera* are present, possibly owing to its destruction by the latter. The mechanical breaking up of the ground after the cotton harvest, to destroy pupae, and the maintenance of a close season for cotton in October and early November are the usual control measures. As a result of large-scale experiments on the effect of different forms of cultivation on the mechanical destruction of the pupae in winter, recorded in the third report, growers are advised to disk-harrow the ground immediately after uprooting the plants, soon after the picking of the crop has been completed, and to allow the soil in this disturbed condition to dry out for as long as possible in the hot weather before preparing it for the planting of

the maize crop, which follows cotton in the rotation. Heavy rollers crushed only about 20 per cent. of the pupae introduced into loosened soil and are therefore considered ineffective. The first two reports include preliminary observations on photoperiodic-type perennial cottons that show promise of being wholly vegetative in the summer and are being tested as traps for the early egg-laying by *Diparopsis* between November and January. In 1946–47, two applications of 0·05 per cent. DDT spray or 0·65 per cent. γ BHC dust in March and April caused significant increases in yield. In 1947–48, applications of 25 per cent. DDT emulsion concentrate diluted to give 1 lb. DDT in 50–75 gals. water per acre on 16th and 26th February and 10th April (of which probably only the last was effective) also caused a significant increase in yield, and similar applications of 50 per cent. DDT or BHC wettable powders or of a wettable-powder mixture of 20 per cent. DDT and 10 per cent. BHC increased the yield, though not significantly. Heavy rain prevented more frequent applications. Larvae of *D. castanea* were continuously present in these experiments, and those of *H. armigera* commonest in March. In 1949, applications of DDT emulsion concentrate diluted to give 1 lb. DDT in 25 gals. water per acre in the first week of January and 2 lb. DDT in 50 gals. per acre on 14th and 26th February gave a significant increase in yield when the cotton had received seven tons of compost per acre, but not when it had received none. Two applications of a dust containing 3 per cent. BHC, 5 per cent. DDT and 40 per cent. sulphur, made when the cotton was in its second week of flowering and again five weeks later, caused no significant increase. It is stated in the first three reports that *Dysdercus* appeared in February, but remained scarce for 1–3 months and never reached very large numbers. *D. intermedius* and *D. fasciatus* were much more numerous than *D. superstitiosus* (F.). Damage in the last year was light. One application of 5 per cent. DDT wettable powder to the plants in April or May 1947 controlled adults and nymphs for at least a month. A bait of DDT mixed with cottonseed cake was very attractive to the nymphs and caused heavy mortality. A BHC dust similarly used appeared to be repellent. In the same year, a species of *Monolepta* near *morio* (Jac.) was reported for the first time as a potential pest of cotton. It caused serious damage to the leaves of plants in the early flowering stage, but was readily controlled by a BHC or (in the next year) a DDT wettable powder. It was also found feeding on soy beans and *Lonchocarpus capassa* in 1946–47 and on *Portulaca oleracea* in 1947–48. Adults of *Apate monacha* F. attacked the large woody stems of some of the photoperiodic plants in 1946–47, and *Mimaulus testudo* Schönh. damaged a few plants of African-grown cotton in 1947–48.

Several reports from stations in the Anglo-Egyptian Sudan contain information on insect pests. In accounts of work during the four years at the Kadugli station (pp. 68–71, 68–76, 63–72 and 68–77, respectively), M. F. Rose reports that bollworms (*Diparopsis castanea, Heliothis armigera, Platyedra gossypiella* (Saund.) and *Earias insulana* (Boisd.)) and stainers (*Dysdercus fasciatus* and *D. superstitiosus*) were of little importance, except in November 1947, when *Diparopsis* caused considerable damage. *Podagrica puncticollis* Weise caused severe injury in late-sown commercial areas in 1945–46, but was controlled by dusting with DDT the following season. *Sylepta derogata* was injurious in each year but was controlled by hand-picking infested leaves. In his reports from the Shambat station (pp. 60–67, 59–67, 55–63 and 61–67, respectively) R. L. Knight states that infestation by *Platyedra gossypiella* was severe and general in 1945–46 except in plots sprayed with DDT in emulsified solution. DDT suspension caused marked distortion and fasciation of growing cotton plants at concentrations as low as 0·1 per cent. Spraying with BHC and DDT controlled *P. gossypiella* and *Earias insulana* in the next two years, but not in the fourth, when the substitution of an arsenical spray towards the end of the season appeared to reduce the amount of damage. From Zeidab it is recorded in the

report for 1947–48 (p. 73) that *P. gossypiella* and a Mirid of the genus *Creontiades* are two of the major cotton pests. Both are injurious late in the season, and plants that have a low node number and therefore fruit early would probably escape severe damage.

The reports from Uganda for the first season comprise one from the Kawanda area (pp. 76–81) by J. D. Jameson and one from the Serere area (pp. 83–88) by P. E. Weatherley ; those for the second and third seasons (pp. 79–101 and 75–84) are all by H. L. Manning. Damage by *Lygus* [*vosseleri* Popp.] was mainly light during the three years. Observations in 1946–48 showed that the bugs were attracted to vigorous plants and that the leaf damage they caused was related to early shedding of buds and bolls. Injury was greater on early plantings than on later ones in the same locality.

The reports from Lake Province, Tanganyika, for 1945–46 and 1948–49 (pp. 90–99 and 80–91) are by J. E. Peat, that for 1946–47 (pp. 102–110) by A. N. Prentice and that for 1947–48 (pp. 85–95) by Peat & Prentice. Damage by stainers (*Dysdercus* and *Calidea*) was light throughout the period. Sporadic outbreaks of *Heliothis armigera* are recorded for the first three years, and damage by Aphids during the early-season droughts for the last two. Attack by Jassids was heavy in 1946–47, especially on poor land, and resulted in a very low yield of some late-planted cotton, but light in other years. *Lygus* caused little injury, except in some districts in 1945–46. *Diparopsis castanea* was observed on planted and wild cotton in the Southern Province in the first year.

The four reports from Eastern Province, Tanganyika (pp. 101–105, 112–115, 96–100 and 93–97, respectively), are by A. G. Bebbington. He records that *Platyedra gossypiella* appeared in large numbers very early in 1945, and that the uprooting date was put forward by a month to 31st October in some districts in order to increase the length of the close season. As a result of this, the bollworm practically disappeared in 1946–48. South of the Uluguru mountains, where the uprooting date was a month later, infestation was heavier in 1948. *Dysdercus intermedius* was very numerous and injurious in 1945, when *D. fasciatus* occurred in some numbers and *D. nigrofasciatus* and *D. cardinalis* Gerst. were rare. The stainers were less important in the later years except in 1948 south of the Uluguru mountains. *Calidea* spp. were taken in large numbers in one district in the second year. *Heliothis armigera* caused local damage, its incidence varying from year to year, and both *Earias* spp. and *Helopeltis* spp. caused severe injury in the first year but not in later ones. In an experiment in 1948 to test the effect of DDT and BHC on *Heliothis armigera* and *Dysdercus*, plots were dusted with 5 per cent. DDT or a mixture of 4 per cent. DDT and 0·5 per cent. γ BHC, both in talc, when larvae of *Heliothis* were first seen and again ten days later or with the mixture applied weekly for as long as was thought necessary. In this second case, 11 applications were made, which was probably excessive. The dusts were applied in the early morning or the evening, at about 16 lb. per acre. Insect counts could not be made, but the causes of shedding of squares were analysed and open bolls were examined. The results showed that treatments could with advantage have been delayed for ten days, that two applications postponed serious shedding due to *Heliothis* for two weeks and that continuous treatment almost halved shedding by *Heliothis* during the critical period in June, though it apparently greatly increased that due to *Dysdercus* and other causes in July, possibly because the plants were bearing a heavier crop. Continuous treatment was the only one to give a significant yield increase ; it reduced the percentage of the crop degraded because of staining to 6, as compared with 18 for no treatment.

The report from the Domira Bay station, Nyasaland, for 1946–47 (pp. 117–125) by H. C. Ducker, S. T. Hoyle & W. L. Miller, that for 1947–48 (pp. 103–113) by Ducker and that for 1948–49 (pp. 100–107) by Ducker, Miller,

S. H. Evelyn & M. S. Hastie contain notes on insect pests. The losses due to bollworms were 3–4 times as high in 1946–47 as in the preceding season, and 13 applications of 5 per cent. DDT dust, made weekly or more often if heavy rain intervened, between 28th February and 9th May did not reduce shedding due to *Diparopsis castanea*. Jassid damage was severe on certain susceptible cottons in 1947–48. In 1948-49, stainers (*Dysdercus*) were injurious owing to the lateness and irregularity of the crop ; at least four times as much cotton as usual was stained.

In the reports from southern Nigeria (pp. 123–124, 131–132, 118–119 and 136–137, respectively), it is stated that *Platyedra gossypiella* [*cf.* **35** 342] was absent in 1945–46 but caused the loss of 60 per cent. of the seed produced in 1946–47. *Helopeltis* caused severe damage in 1946–48, and the effects of growing the cotton under early partial shade, of spraying it three times with 5 per cent. DDT suspension, and of both, were tested in 1948–49. All plants grown under the shade of early maize suffered severely from water shortage and grew little until the maize matured. The maximum numbers of *Helopeltis* per plant recorded during the season were 3·2 and 0·2 on unsprayed and sprayed unshaded plants and 1·2 and 0·9 on unsprayed and sprayed shaded ones. The corresponding yields of lint and (in brackets) of seed in lb. per acre were 13 (14), 35 (53), 7 (7) and 5 (10), indicating that *Helopeltis* control with insecticides is possible and results in a substantial increase in yield. However, even the highest yield was poor, and some other factors were evidently limiting production. Observations on test plots at different places in the forest belt showed that attack by *Helopeltis* was slight there, as compared with unwooded areas.

The report from the northern provinces of Nigeria for 1946–47 (pp. 127–131) records that *Platyedra gossypiella* is now a recognised pest in northern Nigeria and may have caused some damage, and that for 1948–49 (pp. 118–135) includes a section on entomology (pp. 126–135) by Q. A. Geering, in which an account is given of observations on the seasonal activity and importance of *Diparopsis castanea, P. gossypiella, Argyroploce leucotreta* Meyr. and *Earias* spp. (*E. insulana* and *E. biplaga* Wlk.). Most of the work was carried out at Samaru in the northern cotton belt. Eggs of *Diparopsis* were first found on cotton on 26th August and were present until the end of December ; there were peaks of oviposition in early September, at the end of October and in mid-November. Larval mortality appeared to be high. Of full-grown larvae collected between early October and mid-December 1948, the percentage giving rise to overwintering pupae increased from 40 to 96·6 between the middle and end of October and reached 100 by 14th November. Few adults had emerged, however, by the end of July 1949. Larvae of *P. gossypiella* were first found in bolls during the third week in October. There were two peaks of population of approximately 3,000 per acre, and any great increase in numbers towards the end of the season was apparently prevented by the progressive onset of diapause, which affected all larvae by about the end of the year. Diapausing larvae kept for observation suffered high mortality due to a parasitic mite, but those that pupated and transformed to adults did so between February and May. Observations in ginneries and seed stores in 1949 on the fate of diapausing larvae in cottonseed showed that ginning removed 36·6–100 per cent. of them and killed 54·4–86·6 per cent. of the remainder. The survivors in the seed had either died or pupated by the end of July. Similarly, only pupae were present by the end of July in bolls left on old cotton plants. The persistence of large numbers of this species from one season to the next therefore seems to depend on survival of adults during August or early breeding on cotton plants that are ratooned or allowed to remain uncut from one season to the next. *Earias* spp. began to oviposit at about the same time as *Diparopsis* but continued on a considerable scale throughout the dry season. Larvae of *Earias* were the first to be recovered and were estimated at 1,297 per acre in

small bolls on semi-senescent plants in the middle of January, after the crop was harvested. Larvae of *A. leucotreta* were first recorded in mid-October and had disappeared by early December, the peak of infestation occurring in the third week of November. Adults of *Dysdercus superstitiosus* appeared on the crop at the end of September, before any ripe bolls were present, and were most prevalent in October. Fifth-instar nymphs appeared in early November, having bred on the first split bolls, and the resulting adults left the crop as soon as they emerged. This was the only stainer encountered on cotton. Observations showed that shedding of buds and bolls caused a considerable loss of crop, but appeared to be largely due to sudden decreases in humidity rather than to bollworm attack. The proportion of the damage to unshed bolls caused by bollworms was relatively low ; where it was highest, *P. gossypiella* was the dominant species. A survey of the principal cotton-growing areas was made in November 1948. In the northern cotton belt, *Argyroploce* caused consistent but relatively slight damage and *Earias* consistent damage that was sometimes heavy. *Diparopsis* and *Platyedra* varied in importance. In the middle belt, conditions were favourable for *Diparopsis*, *Platyedra* and *Earias*, and *Argyroploce* was probably not important. In the southern belt, *Platyedra* was dominant in the early part of the season, *Diparopsis* and *Earias* were of minor importance and *Argyroploce* was absent. Damaged bolls averaged 7,900 per acre, indicating that later attack must have been severe. On cotton at Samaru that was allowed to remain from one season to the next without cutting and on ratoon cotton, only *Earias* was active from February to the end of May. Oviposition was considerable until mid-March, but the larval population was limited by the small number of bolls. Oviposition was slight and sporadic in April and May and ceased in June, and larvae, which were absent over this latter period, reappeared in early July. Eggs of *Diparopsis* were found on 30th May and reached a peak of 7,000 per acre in early July. The first adults emerged at the end of July. Larvae of *Platyedra* were found at the end of June and reached 500 per acre by the end of July, and *Argyroploce* appeared in mid-July and reached 1,500 per acre by the end of that month. Counts in mid-July on ratoon plants at Daudawa, in the northern belt, showed 160 to over 5,000 eggs of *Diparopsis* per acre ; larvae of this species predominated, and small numbers of *Platyedra* and *Earias* were also present. It is concluded that a properly enforced close season in the northern belt would have some controlling effect on *Diparopsis*, *Earias* and *Platyedra*.

Information on insects attacking cotton in Antigua is given in an introductory note on the cotton experiment stations of the West Indies in 1946–47 (pp. 133–136) by J. V. Lochrie and reports from the Antigua Experiment Station by Lochrie in 1946–47 (pp. 137–143) and by Lochrie & J. R. Spence in 1947–48 (pp. 122–130) and 1948–49 (pp. 141–151). It is stated in the first of them that *Platyedra gossypiella* is the main pest, and that its effective control is necessary for the success of the cotton crop. A close season of three months is proclaimed each year, and its strict enforcement is of the highest importance. Ginneries and commercial stores are treated with DDT spray or BHC (Gammexane) aerosol. *Alabama argillacea* (Hb.) is sometimes important, but can be controlled by spraying with lead arsenate. *Dysdercus* sp. and *Nezara viridula* (L.) are destructive in some seasons, and infestation by the latter caused very high losses of early crops in 1946–48. Counts in a lima-bean field in 1947 showed populations of 10,000 per acre in early December and 20,000 a month later, and populations in a cotton field down wind from this showed a rise to 3,000 per acre in late November, with a peak of 4,000 in late December, whereas those in one up wind from the bean crop never reached 1,000 per acre, indicating that the insects were spread from the beans to the cotton by wind. Nymphs made up 40 per cent. of the population on the beans during December, falling off rapidly with the cessation of fruiting, and averaged about 12 per cent. on

cotton. About 90 per cent. of the bolls were punctured and 70 per cent. shed where infestation was heaviest, and all but a small proportion of those remaining on the plants were stained by *Nematospora gossypii*. Infestation by *Nezara* was negligible in the last year. No parasites were found in Antigua, but it is stated in the second of the reports that *Trichopoda pilipes* (F.) parasitised a small percentage of the nymphs in Montserrat. In the last year, young plants were attacked and stunted by *A. argillacea*, and spraying with lead arsenate was necessary from late September until December.

In a report from the Montserrat cotton-breeding station for the year 1947 (pp. 144–148 of the second series), A. S. Harper states that cotton plants grown in soil to which selenium was applied at 3 or 6 lb. per acre four times at intervals of ten days, beginning when the plants were about five weeks old, and in untreated soil, had 3·28, 2·29 and 5·77 per cent., respectively, of their ripe bolls infested by *Platyedra gossypiella*. Although there was a reduction of infestation on the treated plots, complete control was not obtained. The differences in yield were not significant.

McGuffin (W. C.). **Descriptions of Larvae of Forest Insects. *Plagodis, Anagoga, Hyperetis* (Lepidoptera : Geometridae).**—*Canad. Ent.* **82** no. 10 pp. 205–210, 1 fig., 7 refs. Guelph, Ont., 1950.

The larvae described in this part of a series on Canadian forest insects [*cf. R.A.E.*, A **37** 312] are those of *Plagodis phlogosaria approximaria* Dyar, *P. alcoolaria* (Gn.), *P. serinaria* H.–S., *Anagoga occiduaria* (Wlk.) and *Hyperetis amicaria* (H.-S.). All are polyphagous, and occur mainly on various deciduous trees. A key separating mature larvae of the three genera is included.

Pemberton (C. E.). **Some Insect Pests of the Mainland of the United States occurring also in Hawaii.**—*Hawaii. Plant. Rec.* **51** no. 2 pp. 85–87. Honolulu, 1947.

The author gives a list of 134 common insect pests that are established in Hawaii and also occur on the mainland of the United States. Its main object is to indicate the importance of the enactment and enforcement of quarantine regulations against mainland insects coming into Hawaii on aircraft and ships.

Martin (J. P.). **The Fiji Disease Project in Samoa.**—*Hawaii. Plant. Rec.* **51** no. 2 pp. 89–101, 17 figs. Honolulu, 1947.

Of several important diseases of sugar-cane that do not occur in Hawaii, the most serious if introduced would be Fiji disease [see next abstract], since a vector, *Perkinsiella saccharicida* Kirk., is established there and the commercial varieties of cane now grown in the territory have been shown to be highly susceptible to the virus [*cf. R.A.E.*, A **32** 189]. In order to test the susceptibility or resistance of newly propagated Hawaiian canes possessing commercial qualities, a substation was established in 1946 in American Samoa. The disease is present in Samoa, where the virus is transmitted by *P. vitiensis* Kirk. [*cf.* **30** 100] and conditions are favourable for its development and spread. Arrangements were made to grow rows of cuttings of the varieties

to be tested between rows of diseased cane of a susceptible variety (mostly used for thatching) in the presence of a large population of *P. vitiensis*, and growing conditions were made as favourable as possible, as canes making normal growth have been shown to be more susceptible than those growing slowly.

Notes are included on the agriculture of the American Samoan islands, interesting local types of cane observed (mostly eating varieties) and other cane diseases present. One of these was red rot [*Colletotrichum falcatum*], which was rather common in the midribs of the leaves and gained entrance through injuries caused by *P. vitiensis*, which oviposits in the midribs and to some extent in the cane stalks. It affected some of the canes from which cuttings were taken for the test area.

MARTIN (J. P.). **Fiji Disease of Sugar Cane.**—*Hawaii. Plant. Rec.* **51** no. 2 pp. 103–118, 11 figs., 7 refs. Honolulu, 1947.

In connection with the establishment of a substation in American Samoa for testing the susceptibility of Hawaiian sugar-canes to Fiji disease [see preceding abstract], the author summarises the history of the discovery and spread of the disease, the symptoms that it causes and its transmission and control [*cf. R.A.E.*, A **21** 520]. It is stated to occur in Australia, where the vector is *Perkinsiella saccharicida* Kirk. [**21** 520], Fiji and American Samoa, where it is *P. vitiensis* Kirk. [*cf.* **30** 100], the Philippines, where it is *P. vastatrix* (Bredd.) [*cf.* **28** 250], the Solomon Islands, New Britain and New Guinea [*cf.* also **30** 205 ; **31** 294]. It is regarded as the most serious of all sugar-cane diseases and has caused losses of 80–90 per cent. Very few varieties are immune, but some are commercially resistant and can be grown where susceptible varieties have failed. The incidence of the disease varies directly with the populations of the Delphacid vectors, and its spread is comparatively slow where good biological control of them is maintained. It was found to be serious in the wild *Saccharum spontaneum* in one district of Fiji in 1911, and symptoms resembling those caused by it were observed on *Coix lachryma-jobi* in Samoa in 1947. A list of sugar-cane varieties showing their resistance to the disease is included.

VAN DER VECHT (J.). **The Coconut Leaf Moth** (*Artona catoxantha* **Hamps.**). **Part I. Life History and Habits of** *Artona catoxantha*, **its Parasites and Hyperparasites.**—*Contrib. gen. agric. Res. Sta. Bogor* no. 110, 77 pp., 21 figs., 3 pp. refs. Bogor [Buitenzorg], 1950.

Routine surveys of the prevalence of *Artona catoxantha* (Hmps.) and its parasites on coconut made two or three times a year in each village in districts of Java where serious outbreaks were of regular occurrence indicated that local increases in the numbers of the Zygaenid were commoner than had been supposed, especially towards the end of the rains, but that only some developed into outbreaks capable of causing defoliation. In view of the need to limit expenses by restricting the use of sprays [*R.A.E.*, A **28** 231] to incipient outbreaks and the difficulty of recognising these at an early stage, population studies with special reference to normal density fluctuations were made in the field and the laboratory in West and Central Java during 1938–41 [**37** 141]. This paper, which is to be the first of a series dealing with the results, includes descriptions of all stages of *Artona*, a review of work on it in Java and

elsewhere prior to 1938, and an account of its bionomics, but the greater part is devoted to the numerous parasites and hyperparasites associated with it in its larval and cocoon stages and contains information on their bionomics and importance, tables indicating their inter-relationships, a list of the parasites associated with successive stages of *Artona*, and keys to the Chalcidoids [*cf.* **29** 79] and Ichneumonids.

Outbreaks sometimes originate on *Metroxylon*, of which there are extensive plantations near native villages in West Java, and subsequently spread to coconut, but in general, other food-plants, which include *Nipa fruticans*, *Arenga pinnata*, *Zalacca edulis*, oil palm (*Elaeis guineënsis*) and banana, are not attacked unless the normal food becomes scarce. On the basis of the laboratory and field investigations, the duration of the egg, larval, prepupal and pupal stages are given as 5, 18–20, 2 and 8–9 days, respectively [*cf.* **16** 576 ; **37** 141] ; the composition of the food, which varies with the age and physical condition of the trees, appears to influence the duration of development. The most important parasites are *Apanteles artonae* Rohw. [**16** 576], *Neoplectrus bicarinatus* Ferrière and *N. maculatus* Ferrière, which kill the larvae before they have formed their cocoons ; *Cadurcia leefmansi* Baranov (which is the Tachinid recorded by Leefmans as *Degeeria albiceps* (Macq.) [**16** 576 ; *cf.* also **23** 341]), *Ptychomyia remota* Aldr. and *Euplectromorpha viridiceps* Ferrière, which attack the larvae and kill them after they have formed their cocoons ; and *Goryphus* spp. [**30** 319], which attack the prepupae or pupae and of which *G. inferus* (Szépl.) is by far the commonest. *A. artonae* probably occurs throughout the range of its host and exerts important control under normal conditions, but is of less importance during outbreaks [*cf.* **37** 141] ; it is often greatly checked by *Ceraphron* sp. *E. viridiceps* gives up to 40 per cent. parasitism when *Artona* is rare but disappears almost entirely when its host is numerous. *P. remota* is invariably present during an outbreak, when it affords important control, but its occurrence is normally sporadic ; it appears to be able to maintain itself on other hosts in the absence of *Artona*. *Cadurcia leefmansi* occurs as commonly as *P. remota*, which it seems to replace in some places, and may be even more numerous. It is almost entirely absent when *Artona* is scarce, and most active during the later phases of an outbreak.

Mungomery (R. W.). **Control of the "Greyback" Cane Grub Pest, *Dermolepida albohirtum* Waterh., by Means of "Gammexane" (Benzene Hexachloride).**—*Qd J. agric. Sci.* **6** no. 4 pp. 205–226, 7 figs., 1 fldg. map, 11 refs. Brisbane, 1949 ; also as *Tech. Commun. Bur. Sug. Exp. Stas Qd* no. 4.

The life-history and habits of *Dermolepida albohirtum* (Waterh.) on sugarcane in Queensland and early measures adopted against it, chiefly soil fumigation with carbon bisulphide [*R.A.E.*, A **24** 436, etc.] are outlined, and a review is given of recent work on its control by applications of a dust containing benzene hexachloride to the soil [**38** 137, 405–406, etc.].

Nichols (L. E.) & Weddell (J. A.). **The Commercial Use of Dichloroethyl-ether for the Control of Cheese Mites.**—*Qd J. agric. Sci.* **6** no. 4 pp. 227–235, 4 figs., 1 ref. Brisbane, 1949.

Following the successful use of dichloroethyl ether against cheese mites in New Zealand [*R.A.E.*, A **37** 17], it was tested in factory holding-rooms and cool stores in Queensland [*cf.* **36** 363], where infestation has increased in recent years owing to the longer period for which the cheese is stored. The mites

concerned are *Tyrolichus casei* (Oudm.) and a species of *Tyrophagus* referred to as *T. longior* (Gerv.) [*cf.* **36** 363, etc.], which are predominant in the factory holding-rooms, and *Tyroglyphus farinae* (Deg.), which is commonest in cool stores. The first tests were carried out in two holding rooms in which the floors, shelves and cheese surfaces were heavily infested. The dichloroethyl ether was applied as an atomised spray directed so that all cheeses as well as the empty shelves were enveloped in a spray mist. As far as possible marked wetting of the cheese surfaces was avoided. The dosage was calculated on a basis of 1 lb. per 1,000 cu. ft. The first room had a capacity of 5,500 cu. ft. and contained about 15,000 lb. of cheeses (waxed and unwaxed) of various sizes, and 4 pints (6 lb.) dichloroethyl ether was applied at the low pressure of 44 lb. per sq. in. at 79°F. and 73 per cent. relative humidity. The room was then closed for 24 hours, during which time there was an appreciable leakage of the fumigant. After airing, the cheeses were turned and transferred to treated shelves, a further 4 pints dichloroethyl ether was applied at a pressure of 70–75 lb. at 73°F. and 69 per cent. humidity, and the room was closed for 48 hours.

The second room had a capacity of 7,500 cu. ft. and contained 7,000 lb. of cheeses, and 5 pints dichloroethyl ether was applied at a pressure of 70 lb. at 69°F. and 76 per cent. humidity. The room was then closed and the air circulation system operated for 46 hours. After airing, the cheeses were inverted and transferred to treated shelves, 3·5 pints dichloroethyl ether was applied at a pressure of 70–75 lb. at 73°F. and 69 per cent. humidity, and the room was closed for 48 hours.

Examination of samples from the floors, shelves and cheese surfaces immediately after the first treatment showed complete kill of all stages of mites that were in exposed positions, but there was no effect on mites under the cheeses, whether resting on shelves or on other cheeses, or in cracked cheese, into which the mites had penetrated for up to 2 ins. The surviving population was destroyed by the second application except in the cracked cheese, in which mortality was high. Dust scrapings, including eggs, nymphs and adults, from shelves, floors and exposed cheese surfaces were incubated with mite-free cheese in sterile petri dishes in the laboratory for one month and showed no further mite development. Waxed and unwaxed cheeses were retained in the rooms for two months after treatment, and the only mites observed on them were a few in the second room. There was no taint in the rind or interior of the cheese. Two pockets of infestation, however, were found in the first room, which indicated that the lower pressure used there was less effective. Continued observation of the rooms showed that a second complete treatment was necessary after three months. With improved factory hygiene, however, a much longer period of immunity could be expected.

In subsidiary trials, treated cheeses were placed in treated and untreated crates and untreated cheeses in a treated crate and kept for two months in a heavily infested room. The treated cheeses were taken from the second room after the first treatment and each had one untreated surface. The treated crates had been thoroughly sprayed during the room treatments and left for 46 hours between the first and second applications. The results showed only mild and localised infestation as compared with untreated uncrated cheese. The low infestation of untreated cheese in a treated crate indicated that this might represent a practicable method of handling cheese for export. An unwaxed and a waxed cheese that were swabbed with dichloroethyl ether and kept in a heavily infested room for two months became infested but were in a better condition than untreated cheese, which indicated some persistent effect. Both cheeses retained a strong rind odour and taint, but there was no evidence of penetration into the interior of either. After two months none of the treated cheeses showed rind taint. The rinds of a waxed and an unwaxed cheese

examined after storage for six weeks in an atmosphere saturated with dichloroethyl ether had a strong odour, but the interior was free from taint.

Tests of various methods of applying dichloroethyl ether were made in a cool store having a capacity of 50,000 cu. ft. Paper trays containing samples of living mites were exposed in various parts of the room at different levels, some being protected from downward falling spray. In the main test, dichloroethyl ether was applied from an engine spray gun as an atomised spray at a rate of 1 lb. per 1,000 cu. ft. and a pressure of 80 lb. per sq. in. The spray was distributed as evenly as possible over crates and walls and towards the ceiling, and open floor spaces were also treated. The room was then sealed for 48 hours after which examination of the trays showed complete mortality. The flavour of the cheese and the rind was not affected. In a similar trial, in which the fumigant was applied at the same rate as a spray mist by means of compressed air from a fixed spray line suspended at a suitable height, the kill was satisfactory when compared with untreated samples, but the maximum pressure obtained was only 130 lb. per sq. in., and this, together with some unsuitability of the nozzles and the pressure gradient in the pipeline, resulted in poor distribution of the fumigant, so that survival was high in occasional trays. Attempts to apply dichloroethyl ether as a vapour through the pipeline were unsuccessful as there was insufficient heating in the system to prevent condensation. Cheeses treated in the first two ways showed no infestation or taint after export to the United Kingdom. The costs of the treatments are briefly discussed, and it is stated that further large-scale experiments in cheese factories and cool stores showed that dichloroethyl ether applied as an atomised spray is cheap, practicable and effective.

Howard (N. F.), Brannon (L. W.) & Mason (H. C.). **The Mexican Bean Beetle in the East and its Control.**—*Fmrs' Bull. U.S. Dep. Agric.* no. 1624 (revd.), 18 pp., 14 figs. Washington, D.C., 1948.

In this revised edition of a bulletin on *Epilachna varivestis* Muls. in the eastern United States [*R.A.E.*, A **25** 318, etc.], its distribution there is extended to include records from Iowa, South Dakota and Wisconsin. The only insecticides now recommended without qualification for its control are sprays and dusts of rotenone as derris or cubé.

Papers noticed by Title only.

Thompson (W. R.). Ed. **A Catalogue of the Parasites and Predators of Insect Pests. Section 1. Parasite Host Catalogue. Part 11. Parasites of the Neuroptera, Odonata, Orthoptera, Psocoptera, Siphonaptera and Thysanoptera.**—$10\frac{3}{4} \times 8\frac{1}{2}$ ins., [1+] iv+35 pp. multigraph. Ottawa, Ont., Commonw. Bur. biol. Contr., 1951. Price $ (Canad.) 2. (Also obtainable from the Commonw. agric. Bur., Farnham Royal, Bucks, price 10*s.*) [*Cf. R.A.E.*, A **32** 106; **38** 264.]

Nesbitt (H. H. J.). **On a new Argentinian Mite,** *Diphtheroglyphus maculata* **n. sp., n. gen.** [found in numbers on salted steer hides], **and the taxonomic Position of the Family Pontoppidanidae Oudms. 1925.**—*Canad. Ent.* **82** no. 10 pp. 211–216, 7 figs., 9 refs. Guelph, Ont., 1950.

Feinstein (L.) & McCabe (E. T.). **New** [colorimetric] **Tests for the** *Nicotiana* **Alkaloids, Nornicotine and Anabasine.**—*Science* **112** no. 2914 p. 534. Baltimore, Md., 1950.

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